THE

# FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

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# A Review of the Foundry Industry in 1936

Probably the factor of major importance last year, so far as international trade was concerned, was the virtual disappearance of the gold *bloc*. France departed from the gold standard in October, and this had a profound influence on international commerce, by tending to free the world from the stranglehold of economic nationalism. The immediate repercussion on France, despite the incidence of the industrial unrest, was to strengthen the position of the foundry industry, though conditions slightly resembling anything of a trade boom have yet to be experienced in that country.

In Germany, trading conditions were distinctly better, but mainly because of their rigid currency restrictions their export trade was handicapped. The central and eastern European countries—one of Germany's main markets—have also been assiduously seeking economic nationalism, and the reports we publish from Czecho-Slovakia and Poland show that these countries are rapidly providing themselves with an efficient and expanding foundry industry, not merely capable of supplying their own domestic needs, but in many cases of entering the export market with a considerable degree of success. Czech steel castings and Polish baths are typical examples of such enterprise.

The Scandinavian countries are unquestionably developing their foundry industry along intelligent lines, and a closer co-operation from their technicians in international matters would be welcomed. This in plain English means an international congress, to be held in one of these countries, would be appreciated internationally.

After an absence from our last annual review number, the report by Dr. Guido Vanzetti is especially interesting. The discovery and utilisation of the indigenous mineral resources is just one more example of the old adage "necessity is the mother of invention," and thus in certain cases "sanctions" have been a blessing in disguise. From a metallurgical standpoint, Italy is of outstanding interest, as it has built up an efficient large-scale heavy steel industry, whilst handicapped by the almost entire absence of coal and iron ore.

Belgium has staged a remarkable recovery in its foundry industry. Under modern conditions this country, in common with all the smaller nations, is precluded, because of the relative smallness of the home market, from manufacturing motor vehicles, especially as all the larger markets have imposed tariffs verging on the prohibitive against foreign imports. Many of the European countries are still making strenuous endeavours to bring in all foundry owners as members of their employers' federations in order to minimise the evils of price cutting. In Germany and Italy each foundry is *force majeure* a member of the appropriate employers' association, and this is a factor in international business which must be borne in mind by British supporters of "individualism." Japan, too, is similarly organised.

Reports from the United States show that prosperity has again returned to that great country and the only factor adverse to straight-line progress is the possibility of widespread labour troubles.

## Light Castings

Backed by an extremely intelligently conducted employers' federation—The British Ironfounders' Association—this section of the industry has had an extremely prosperous year. Whilst business on the international market has not been easy to get, there has been a substantial gain in quantity (well over 1,000 tons), but in general at some sacrifice in price. Official reports show that another 10s. per ton has been cut from the export price of stove grates. The home market demand for rain-water goods for use in connection with the various re-housing schemes and to meet the definite increase in building of houses by private enterprise has been adequate to keep the shops working at full capacity.

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Unemployment has been reduced to a negligible figure, in spite of the considerable mechanisation that has taken place. Amongst the latest foundries to adopt a continuous casting system is Southern Foundries at Croydon, a works associated with Federated Foundries, Limited. The raw material position is still reasonably satisfactory, but here and there delays in delivery are giving rise to a certain amount of apprehension.

The bath section of the industry has probably experienced a record year for production, and, but for worries in connection with price cutting emanating from a certain quarter, would have had a revenue commensurate with the great efforts they have put forward in the direction of plant modernisation. In this connection, it is interesting to note that a complete and highly mechanised plant has recently been supplied from Germany to an English bath foundry. It was shown in operation at the Düsseldorf Foundry Exhibition. The gas cooker firms have been exceptionally busy, and if statistics could be produced they would show an output exceeding one million units had been made during the past year, whilst the production of electric cookers of all types was probably of the order of 200,000. This great section of the foundry trade is still threatened with competition from steel pressings, but if there is a tripartite co-operation between the manufacturers of continuous casting plants, the interests controlling the structure and composition of the metal and the enamelling technologists, steel plate replacement will be long delayed if not permanently excluded as a major material of construction. Makers of pressings are, by the way, being helped very materially by the introduction of high-duty cast iron for replacing expensive special steel dies for use with the presses.

## Pipe Founding

The preference of the public works authorities for pipes manufactured by the centrifugal process becomes more marked every year, and to-day the position is that the spun pipe virtually dominates the market. Nearly all the great pipe foundries have now adopted the process and new plants or extensions to existing ones were put into operation at Stanton, Cochranes, Staveley and Clay Cross during the year. Employment has been well maintained and the position in the export market has been ameliorated somewhat. Slightly higher prices have been obtained for an increased volume of the several thousands of tons of pipe exported. There is a tendency for imports of pipe to increase, and the £50,000 mark was exceeded last year.

## Motor Vehicle Castings

Once again a new high level in the production of motor vehicles has been reached, and the United Kingdom has now the second largest production in the world, even though it be but one-tenth that of the United States, which also dominates the export market to the extent of supplying two-thirds of its requirements. Yet in recent years the United Kingdom has increased both production and exports by 75 per cent. The foundries catering for the motor vehicle industry rank amongst the most up to date in Europe, and one of them this year proposes to spend £200,000 on a thorough re-equipment. Though their work is unfortunately seasonal, an excellent average of employment has been achieved. Much progress has been made in the production of alloyed cast crank shafts, and its success is testimony to the great field open to those prepared to exploit to the fullest extent the results of research on cast iron now readily available to the industry. The methods of manufacture employed by the motor vehicle industry are well worth careful scrutiny by other foundries engaged in repetition produc-

tion, as, contrary to general belief, the most modern motor-car foundry does not mass-produce. It manufactures only such quantities of castings as can be easily absorbed by the machine shops without piling up vast stocks of semi-finished components. In theory every casting is kept moving continuously until complete absorption in a finished unit is effected, or it is packed for delivery as a spare part.

### Electrical Engineering

The foundry industry has continued to make a very serious contribution to the technical efficiency of electrical components. The type of casting described and illustrated in Dr. Guido Vanzetti's review have been made in large quantities in Sheffield works, some of which are yet scarcely integrated with the industry. The old-fashioned Sheffield crucible process is used as a melting medium and the impression one receives is that moulding has been grafted on to steel-making rather than the supply of liquid metal being an incidental. Most of the largest electrical engineering foundries now possess continuous casting systems for their lighter requirements. A fair proportion of heavier components which were formerly made as iron, malleable or steel castings are now being fabricated by welding, yet in spite of this there has been about a 25 per cent. increase in the foundry personnel. In their annual reports most of the firms consider that their export trade is improving. Most of the foundries are working to capacity.

### Jobbing Foundries

The position of many of the jobbing foundries is definitely unsatisfactory, especially those situated in the heart of the country. Their skilled workmen, like the farm labourers, are being attracted to the large towns, whilst the departure of the municipal castings business to the large speciality foundries has left them little but the making of plough shares and items such as pig troughs. We would like to see the large foundries "feed" some of these tiny country shops where the owner is also a working moulder. The output of the jobbing foundries in the large cities has been adversely affected by the inability to secure skilled men.

### Metallurgical Foundries

The technical improvement in the foundries serving the heavy iron and steel industries noted last year has been consolidated and an outstanding contribution to the subject has been made in a Paper by Mr. R. Ballantine. Naturally, the record output of approximately a million tons of steel ingots per month has provided ample work for the ingot mould foundries, but improved technique has materially lengthened the life of the individual mould, and spacing in the pit has been an ameliorative factor of prime importance. Rolls, too, are lasting much longer with an obvious repercussion on the foundry, which only present capacity conditions are masking.

### Shipbuilding

It is pleasing to report that at long last conditions have become distinctly better. Tyneside is now beginning to resemble its former self, but much still remains to be done before the boom conditions of other days reappear. Prospects are better than they have been for many years, and we fear that progress will be hindered by a shortage of skilled men. A very serious contribution to prosperity in this industry is being made by the Naval construction programme and by the construction of the 552, sister ship to the "Queen Mary."

### Agricultural Implements and Dairy Machinery

There has been a distinct improvement in all branches of the industry manufacturing farming implements and prime movers. Until last year, it can be said that, with few exceptions, the industry never shook off the enormous handicap placed upon it by the virtual cessation of its legitimate business during the war period. The well intentioned attempt at financial integration of a decade ago ended disastrously, with the permanent closing down of a number of old established firms. Those which survived only did so by the exercise of a maximum of business acumen. R. A. Lister, Limited, of Dursley, have announced a serious capital expenditure for the mechanising of a part of their foundry.

### Textile Machinery

After years of instability, financial losses, bankruptcies, absorptions and the like, the major portion of the textile foundries have now found a new and better level, and reports from the North Midlands indicate that the volume of orders available is ample to keep the foundries working to a capacity well able to place them on a profit-making basis. One foundry, which was only rebuilt two years ago, has found extensions to be necessary. We warned industry some time ago that there was a recommendation printed in the Annual Report of H.M. Chief Inspector of Factories for the revision of conditions under which female and boy labour may be worked, and the Government intends acting upon this. If this results in adding to the export price of textile materials there may be some diminution in the demand for castings.

### Malleable Castings

There have been considerable extensions to the floor space available for making malleable castings, due to increases in the labour force ranging from 10 to 35 per cent. In general, this industry is but little affected by the re-armament programme and its progress must be ascribed to a general improvement in the home market as exports are not a factor of major importance. The foundries in the Black Country are beginning to be a little concerned about delivery, especially of hematite—a factor usually ascribed to the Spanish civil war, though we are not too seriously impressed by this reasoning, as other sources of supply are easily available.

### Steel Foundries

We pointed out, when reviewing the brilliant Report on the economic conditions of Germany written by the Commercial Attaché at Berlin, that armament production had a profound influence on the steel castings industry. Only a few years ago, this section of the industry was, from a national point of view, almost bankrupt. The Steel Castings Association was discussing the buying up and dismantling of redundant plant. To-day, there is a shortage of capacity. Iron-foundries are being tempted to enter the business, money is being invested in new equipment, extensions are being envisaged. In short, within the short space of two years there has been a complete metamorphosis from the depths of depression to capacity output. Naturally enough, there is a shortage of moulders in some areas. We ask steel-foundry owners to take full cognisance that whilst they have many other important lines—shipbuilding, mining machinery, steel-works, quarry plant, automobile work and so on—they must realise that for boom conditions they can only rely on armament work, and they must legislate now for the steps they are to take when the demands of the Admiralty and War Office slacken off.

### The Non-Ferrous Industries

All the largest firms making important castings for the engineering, aircraft and general armament industries are working at full pressure, whilst there has been steady employment for those engaged in plumbers' castings. The industry is employed in general up to 95 per cent. capacity, and here and there considerable extensions are taking place. During the year a really modern brass-foundry was put into operation by Babcock & Wilcox.

### Light Alloy Castings

With the intense development of both civil and military aircraft, coupled with a high record in motor vehicle production, this essentially progressive section of the industry has enjoyed excellent trading conditions. We recently visited a large pressure die casting shop, utilising *inter alia* the Polak machines described in Professor Pisek's article.

### Foundry Equipment

We very much doubt if any section of the industry is busier than that devoted to the supply of foundry plant. We have circularised a carefully selected list of foundries to embrace the largest and the smallest, and have covered every major activity undertaken, and we sincerely thank our many friends for their co-operation. The return was of the order of 95 per cent., and it shows an extraordinary state of activity. The industry is obviously working at over 90 per cent. capacity, despite a few rather low figures returned from marine engine foundries, but the most surprising factor of all is that 66 per cent. of the firms are either extending their shops, installing new plant or are embarking on modernisation proposals. In answer to our inquiry which read: "Have you recently made or are making any serious extensions to your foundry plant," we will give the following ten replies, taken alphabetically from the middle of our list:—(1) New sand-handling plant, modernised drying stoves, new coreshop; (2) not recently; propose making extensive alterations to bring remainder of works in line with continuous plant; (3) January to October, 1936, spent £60,000; (4) no; (5) no; (6) moulding machines and similar plant being replaced with more up-to-date models; (7) have recently put a further 2,400 sq. ft. on the foundry building; (8) no; (9) spent £12,000 on new plant; and (10) yes. Of new foundries installed, that of David Brown & Sons (Hudd.), Limited, at Penistone, is of especial interest, as it is operating the Randupson cement-sand system of moulding.

### Conclusions

All the above indications point to a maintenance of the good conditions now prevailing in the trade for 1937. If the volume of trade is not increased, it is largely because plants are working to capacity and restrictions are due both to the shortage of raw material and of labour. The former places some consuming plants without proprietary interests in plants making primary products, in a rather awkward situation, and pig-iron producers themselves have been responsible for some moves to secure imported material. The main index to the activity of the iron and steel industry is the production of pig-iron, which in 1935 only fell short by a small margin of the figure for 1929, which in turn has for long been a standard of high output for the post-war period. It appears, however, that 1936, even for the first eleven months, yielded a figure larger than 1929, which showed a figure in excess of ten million tons. So far as founding itself is concerned, the position seems to be strong in all branches, cast iron, steel, malleable iron and non-ferrous.

The price situation shows no signs of getting out of hand. Although advances have taken place, it has not made the market any more fluid, and in spite of them producers seem desirous of limiting their commitments, which suggests that further hardening will take place at some future date.

Altogether the indications for 1937 are in the highest degree favourable, and those who by exercise of ingenuity can increase output with existing labour will reap their reward. A further stimulus will be given to continuous and mechanised production and the equipment branch of the industry will be busy accordingly.

# The Work of the Institute of British Foundrymen

## By HARRY WINTERTON (President)

SUCCESSIVE Presidents of the Institute of British Foundrymen have been called upon for a considerable number of years to give their impressions, in this annual *résumé* for the organ of the Institute, of the work that is being carried on, but I question whether any individual President has ever taken over the reins of office at a time fraught with so much activity and definite endeavour to forge ahead as was the case in 1936.

For several years the Institute has been blessed with Presidents whose activities were never-ending and whose ideas as to the advance of the Institute itself were very definite, very progressive and very practical. Hence the Institute is becoming more and more a thing of teeming activity and widespread interest. Always keeping before their minds the original objects of the Institute, my predecessors in office have been progressing on definite lines and have endeavoured to embrace in the ambit of the Institute's labours every branch of foundry work that could possibly be said to benefit the foundry trade in any way.

Last winter Papers of outstanding interest were presented to the various Branches, and the interest that was shown in those Papers, as evidenced by considerable extension of the discussions, progressed in ever-increasing force as time went by, and apparently there was in many of the districts quite a feeling of regret when the time came for a suspension during the summer months of the Branch meetings.

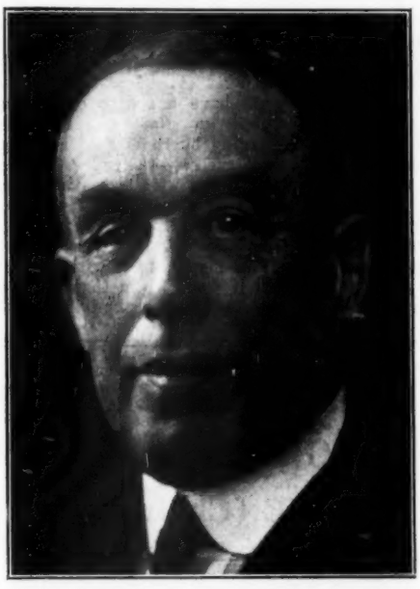
As is well known, the Annual Conference was held at Glasgow in June, and, without being invidious, I think it may be said to have been amongst the very best gatherings that have taken place. The work was continuous, possibly too continuous for those who prefer relaxation, but certainly not too continuous for some who look to the Conference to clear away, or to afford enlightenment on, various problems with which they have been faced during the year. Before leaving the subject of the Conference I would like wholeheartedly to express, as President, my keen appreciation of the cordial hospitality meted out to the members by the Civic authorities of Glasgow and Edinburgh, and by the various firms at whose invitations works visits were made. The hearty geniality of the Lord Provost of Glasgow made a deep impression upon many of the visitors from the South, who also made the acquaintance, many for the first time, of the lady magistrate who deputised occasionally. The cordiality, too, of the Senior Bailie and other magistrates of Edinburgh was but enhanced by the fair beauty of their city, which, on the day of the visit, basked in the glorious sunshine so often associated with towns on the East Coast of Scotland.

Much of the energy which my predecessor, Mr. J. E. Hurst, expended during his year of office has already begun to bear fruit, and it is hoped that, as a result of the foundation which he laid, a larger, more powerful and more effective Institute may result. To this end it might be politic here to refer to the enormous amount of assistance which might be accorded to the Institute by some of the leading foundries in the country, whose help to the Institute up to the present has not been so pronounced as might have been wished. Certain it is that quite a number of firms are wholeheartedly enthusiastic about the Institute and its work, but there is room for much more development and opportunity for extensive expansion on educational lines, of which full advantage would be taken by the younger members of the industry if they received that encouragement from their employers which the circumstances demand. Often we hear it declared that there are far too few men capable and ready to take over charge of foundries or to assume the responsibilities of control. If the objects of the Institute had the help of all the principal foundries in the country and the aid and goodwill of those hundreds spread throughout the land which employ in the aggregate thousands of hands, there would soon be far less cause for a complaint of this character.

Every possible assistance by the Institute is given to the younger men, who are invited to attend the various meetings at which Papers are given by practical foundrymen, and technical Papers are also presented by leading foundry technicians. With the object of improving the position, various ideas are being brought forward, and it is hoped that when these schemes come to fruition, not only will the status of the Institute be raised above its present level, impressive though that may be, but that membership of the Institute will constitute a recommendation throughout the country as the mark of a man skilled not only in practical ironfounding, but in its highest technicalities.

All those members of the Institute who visited the International Congress and Exhibition at Düsseldorf in September must have been impressed by the completeness of the schemes of our German friends. Everything seemed to have been done on a thoroughly finished scale, and although at first, owing to the unexpected last-moment rush, there was some little confusion, the Congress eventually settled down into a continuous stream of instruction and practical demonstration. Praises of the Exhibition itself were heard on every side and in many languages, and the members of the delegation were offered unique opportunities of obtaining an insight into the lives of the German people as they are lived to-day. It must be confessed that thoroughness seemed to enter into the composition of everything, and although the temperament of the British possibly might not be completely attuned to the mode of living on that part of the Continent, it must be admitted that, generally speaking, the effectiveness of the methods was certainly in evidence on every hand.

This confraternity of thought and action for the advancement generally of the objects of this and similar Institutes might be extended, with a very considerable effect and with general acceptation, to the various associations in this and other countries. Certain it is that a complete exchange of ideas must lead to a general improvement in the trade, and the solving of various problems connected with the manipulation of iron and other metals which from time to time seem to evade the demonstrative solutions, but which, when placed before practical men, are of such convincing eloquence.



MR. H. WINTERTON.

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THE INSTITUTE OF BRITISH FOUNDRYMEN.

*Members.*

| | |
|---|---|
| Honorary | 16 |
| Subscribing Firms | 52 |
| Members | 783 |
| Associate Members | 950 |
| Associates | 141 |
| Total | 1,942 |
| Branches | 10 |
| Sub-Sections of Branches | 6 |
| Junior Sections | 1 |
| Committees of Council | 6 |
| Technical Committee and Sub-Committees | 10 |
| Institutions on which the Institute is represented | 18 |
| Branch meetings during 1936 | 110 |

*Papers presented.*

| | |
|---|---|
| Cast Iron | 19 |
| Steelfounding | 5 |
| Non-ferrous | 8 |
| Moulding, Coremaking and Patternmaking | 15 |
| Sands and Refractories | 9 |
| Furnaces and Fuels | 7 |
| Organisation | 5 |
| General Discussions | 10 |
| Branch and Section Presidential Addresses | 13 |
| Miscellaneous | 18 |
| Total | 109 |
| Nationalities represented in membership | 11 |
| Countries in which members are resident | 17 |

It will be noted from the table which is inset that there are already eleven nationalities represented in the membership of the Institute, while the countries in which members are resident number seventeen. The international conferences which have been held recently, notably that in Germany last year and that in Belgium in 1935, attracted even more nationalities. In Belgium in 1935 there were twenty-two different nations represented at the gathering, while at Düsseldorf there were even more.

At home, too, there is a tendency for the institutes concerned with the various branches of the iron, steel and non-ferrous trades to welcome visits from kindred societies, and at the latter end of October a great step forward was made in this direction when a joint meeting of the Iron and Steel Institute and the Institute of British Foundrymen was held in London under the chairmanship of the President of the latter Institute. Although it might be said that no definite conclusions were arrived at, it was felt that the meeting was a very promising forerunner of most interesting and instructive similar gatherings in the future. Sir Harold Carpenter struck the right note when he opened the proceedings, and he was followed by several eminent metallurgists, who imparted considerable weight to the discussion. It is my sincere hope that these joint gatherings may increase considerably and lead to similar meetings with other learned societies in the metallurgical world.

It is well known that the Institute offers very considerable encouragement to those who care to study closely the work of the Institute and its relation to the practical and technical handling of metals. It is becoming a definite recommendation to have obtained the Oliver Stubbs Medal or the diploma of the Institute, whilst in junior circles the John Surtees Medal and the Buchanan Medal are incentives to really hard work.

The institution of the Edward Williams lecture was an instantaneous success, and the second lecture, which was given at Glasgow at the Annual Conference by Prof. Mellanby, was no less successful than that of the previous year. Next year at Derby another very eminent personality has consented to give the third lecture. Now there has been established the E. J. Fox Medal, which is to be awarded to any individual, whether connected with the foundry industry or not, who is acknowledged to have done outstanding service for the advancement of the science of ironfounding by his activities.

The work of the Branches during the year has been real and energetic, as is shown by the increase of membership and the institution of another section at Ipswich, where much work has been done under the ægis of the London Branch. This Branch took part in a most successful joint meeting in London with the Birmingham and Coventry Branch, and it is hoped that more of these gatherings will be arranged.

The somewhat isolated position of the South-West of England makes it difficult to form a Branch which would have a centre convenient for its members, but an effort was made in November—and, judging by the initial meeting, with every chance of success—to form a Section of the South Wales Branch, with a meeting place at Bristol. Taking into consideration the fact that many queries are addressed to members and to officials from the West Country dealing with such problems as may be met with day by day in the foundry, it would seem that there is ample scope for this new section, and it is with sincere hope that I commend it to the foundrymen of the West.

All the other Branches have been busy during the year. Newcastle has once more become a live Branch, notwithstanding the deep industrial depression which has existed in the Tyne districts for so long. Lancashire, Sheffield, the East Midlands, West Riding and Middlesbrough have added their quota, both Branches and Sections doing well, and it is quite within the bounds of possibility that the Edinburgh Section will follow the example of the Falkirk Section and become a pillar of support to the strong and vigorous Scottish Branch, which has always been so definitely in the van with its whole-hearted support of the Institute.

As I suggested in the opening paragraphs of this article, the Institute has for thirty-two years been doing good service to the foundry industry. What of the future? At the moment trade is developing in all directions, not necessarily due to any particular Government encouragement, but due, in the main, to the general re-awakening of trade throughout the Empire. But we in Great Britain are not alone in our desire for development and advancement. Other countries are making definite progress, and if we are to remain in the forefront, we must make up our minds very definitely, very emphatically and very earnestly that we will do everything in our power to endeavour to inculcate the desire for education amongst our workers, to add to practical education the enlightenment of the technician, and to blend all our energies into a definite creative whole which not only will keep us in the lead, but encourage the rising generation to continue to advance and develop their profession on the most practical and scientific lines.

# The Vitreous Enamelling Industry and The Institute of Vitreous Enamellers

## By W. H. WHITTLE (Chairman of the Institute)

IT is proposed to divide this article into two distinct sections, the first of which will deal with the activities of The Institute of Vitreous Enamellers and the second will be a general statistical survey of the industry, and in this connection the author wishes to thank the Editor of the FOUNDRY TRADE JOURNAL and all those who have collaborated with him in the amassing of so much information. The result is, that for good or evil, a reasonably detailed survey of the size and scope of this industry is for the first time being presented.

### The Institute of Vitreous Enamellers

The matter of major importance to its members is that, after prolonged negotiations, a trade sign has been granted to the Institute and this constitutes a potentially valuable instrument for achieving real progress as an industry; but its value will naturally depend upon its use being restricted to only those materials of which the manufacturers are justly proud and which they have every reason to think will give satisfaction to the user. This trade sign will shortly be available as transfers and tie-on labels, and its issue will be accompanied by appropriate trade literature destined to appeal both to the retailer and the ultimate user.

Membership of the Institute is increasing, but naturally the original rate of recruitment is being slowed down. The main factor, however, is that interest in the Institute's work is increasing and attendance at the meetings is greater rather than less. Last year a start was made with international co-operation, and the first Exchange Paper from the German association concerned with vitreous enamelling was presented by Dr. Karmaus, of Berlin. A second

MR. W. H. WHITTLE.

phase is the proposal to organise a visit to the United States in the autumn, when it is hoped a really representative delegation will participate.

The Institute has again been fortunate in having such an eminent scientist as Dr. J. W. Mellor as President. The Institute is indeed grateful for the efforts he is making to establish some system of co-operative research. His advice on education has also been most valuable, and the Council has under consideration at the present time schemes for training the younger members of the industry (actually, classes have been formed at Wolverhampton), the supply of young technicians of University degree standard, and associated problems, such as the provision of standardised analyses and research work.

In general, there is every reason to be satisfied with the results actually accomplished and the programme for development.

### A SURVEY OF THE INDUSTRY

#### Historical Details

The art of enamelling was confined for many centuries to the decoration of metals, and until about the year 1800 no practical use was made of the process. Vitreous enamelling on cast iron appears to be of French or German origin, the first English patent being granted to Dr. Sandy Hickling in 1799. Some vessels were manufactured under this patent, but a more satisfactory process, the patent of C. H. Paris, was worked in Birmingham from 1830 onwards. This applied to stamped hollow-ware and cast-iron vessels as well as to enamelled advertisement plates.

Early workers after Hickling and Paris were T. Clark (T. & C. Clark, of Wolverhampton), T. Nachin, of the Potteries, and Archibald Kenrick, of West Bromwich. Other firms came into evidence during the middle of the nineteenth century and are trading successfully to-day. The white porcelain effect was first produced by

Cannon Iron Foundries, who made the first roll-edge cast-iron bath.

Many of these early companies based their formulæ on that of Stourbridge flint glass. Secret recipes and methods were for many years the vogue, and even to-day many of the officials, who have grown old in the service of these long-standing firms, are imbued with the spirit of secrecy, and continue with old rule-of-thumb methods which would be more suitable for the experiments of an alchemist.

The development of the industry during more recent years follows improvements in the technology of iron and steel and, possibly of even more importance, the provision of alternative raw materials, such as pure and cheap chemicals. Le Blanc-Solvay new borax deposits, the Stassfurt materials, all have had their influence on the enamel industry, whilst Bessemer, Gilchrist and Siemens-Martin processes have brought forth new foundation metals.

Modern developments followed, including sand-blasting, pickling, sprayers, continuous furnaces and mass production. In this country, at any rate, there has very recently developed a tendency towards the purchase of more finished materials for frit and enamel making, and in some cases the purchase of enamel to specifications.

The enamelling industry can be divided conveniently into three parts:—(1) The bath industry; (2) the electric and gas appliances industry, and (3) the hollow-ware industry.

There are a few examples of the overlapping of these broad sections, but this is rather unusual and, generally speaking, the groups indicated are self contained. In group (2) there is only minor overlapping of the gas and electric sections.

### The Bath Industry

The International Bath Association, Limited, covers about 28 manufacturers and distributors of baths in the United Kingdom and also several Continental manufacturers, chiefly in Germany and Czecho-Slovakia. It exists primarily to ensure an economic price for baths, and it is making an attempt to standardise the design of baths, as there are at present about 1,000 different models available to the British public. Its chief effort at stabilisation is the introduction of the "Artisan" bath and the "Magna" bath with standard side and end panels finished with synthetics. An estimate of the total production for 1934 is 415,000 baths.

### The Electric and Gas Appliances Industry

In this section there are a few big firms operating on the larger type of product (cookers and refrigerators) and many small firms interposing with production of smaller types (radiators, fires and a multitude of domestic appliances). An estimate of the total production of gas cookers for 1934 is 1,000,000. An estimate of the total production of electric cookers a year is about 200,000. In the refrigerator trade there are many electrically operated cabinets, but some of these are imported.

### The Hollow-Ware Industry

It is convenient to group in this section all the firms who are engaged in the manufacture of hollow-ware of all types, together with the manufacture of hearth plates, enamelled signs, and other products of a miscellaneous type. The majority of these firms are situated in the district between Birmingham and Wolverhampton, and, collectively, they are an important portion of the industry, particularly in the locality where they are situated.

### Statistical Information

*Production.*—The available data on the production of enamelled articles are contained in the reports on the Census of Production and in reports prepared under the Import Duties Act. Figures are thus available for the years 1924, 1930, 1933, 1934. The full figures are available for the industry, and the following are the statistics for 1934.

| | Tons. | £ |
|---|---|---|
| Baths of iron and steel— | | |
| Wrought, enamelled, of a description commonly used for domestic purposes .. .. | 35,700 | 1,057,000 |
| Other kinds .. .. .. | 11,000 | 271,000 |
| Hollow-ware for domestic purposes— | | |
| Of wrought iron or steel, enamelled .. .. .. | 22,300 | 1,343,000 |
| Of cast iron, enamelled .. | 200 | 8,000 |
| Enamelled signs and tablets and hearth plates .. .. .. | — | 380,000 |

There is no further information available on enamelled products alone, but the following items must necessarily include at least some products which were actually enamelled.

| | Tons. | £ |
|---|---|---|
| Cast-iron stoves, grates and ranges for domestic cooking and heating, and parts and fittings therefor— | | |
| For coal and other solid fuel .. | 128,400 | 3,636,000 |
| For gas .. .. .. .. | 88,600 | 5,575,000 |
| For electricity .. .. .. | 8,200 | 404,000 |
| For liquid fuel .. .. .. | 1,800 | 93,000 |

It is impossible to determine how much of this was enamelled, and other methods of calculating the usage of enamels have been used. Similarly, although the output of cooking and heating apparatus appears in the Import Duties Advisory Inquiry, as shown below, the enamelled proportion is quite unknown.

| | £ |
|---|---|
| Electrical heating apparatus — | |
| Domestic .. .. .. .. .. | 1,418,000 |
| Commercial .. .. .. .. .. | 51,000 |
| Industrial .. .. .. .. .. | 238,000 |
| Electrical cooking apparatus .. .. .. | 86,000 |
| Electrical refrigerators (under 1 ton) .. .. .. | 436,000 |

The figures for the four individual years indicate the increasing use of enamel ware, the growth of electrical equipment, and, to some extent also, the activity of the building industry in recent years. In this latter connection it is interesting to interpolate the following section on the relationship between building activity and the production of baths. It should be noted that the crude production figures have not been adjusted for imports and exports, as these are shown below to be relatively unimportant, and so have no serious effect on the figures assumed.

The following are notes on the relationship between building activity and the production of baths. They represent opinion only and are not intended to be substantive facts.

The numbers of dwelling houses and flats built in the given year are known, and, in the first place, the baths required for other buildings (hotels, hospitals, etc.) are ignored. Thus, the number of baths made is shown in relation to houses and flats built.

| | 1924. | 1930. | 1933. | 1934. |
|---|---|---|---|---|
| No. of baths (assuming 2¼ cwt. each) .. .. | 153,000 | 199,000 | 369,000 | 415,000 |
| No. of dwellings | 109,000 | 176,000 | 244,000 | 337,000 |
| Excess baths over dwellings .. | 44,000 | 23,000 | 25,000 | 78,000 |
| Ratio—baths : dwellings .. | 1.40 | 1.13 | 1.51 | 1.24 |

The possible reasons why this ratio is not constant and equal to unity include the following:—(*a*) Some new dwellings may have no baths; their number, however, is probably negligible. (*b*) A few private houses have more than one bath. (*c*) Baths are used in hotels, hospitals and other institutions besides private houses. The number of bathrooms being installed in such buildings is not known, but even assuming a ratio of bathrooms to other rooms several times as great as in private houses, it cannot be large, for there is in existence less than one hotel for every 1,500 private houses, and the annual total expenditure on hotels and other bathroom-containing buildings can scarcely be more than 1 to 2 per cent. of that on dwelling houses. (*d*) Replacements of baths are made in existing houses. Probably the most frequent occasion for this occurs when people move into houses in which an old type of bath is in use, but the replacement of the bath is seldom essential, and will be general only when times are relatively prosperous. (*e*) There will be a carry-over of stocks from one year to another.

There are no statistics enabling these factors to be properly assessed. Various conjectures have been made, and, while none of the latter is susceptible to any kinds of check, the conclusion has been reached that the following imaginary, but possible, picture of the situation may be as near the truth as any. For this purpose the factors enumerated as (*a*), (*b*) and (*e*) above are assumed to cancel one another out, while factors (*c*) and (*d*) are allowed for as shown:—

| | 1924. | 1930. | 1933. | 1934. |
|---|---|---|---|---|
| Baths installed in new private houses, allowing an average of one per dwelling .. .. .. .. .. .. .. .. | 109,000 | 176,000 | 244,000 | 337,000 |
| Baths installed in hotels, hospitals and other institutions, assumed at about 6 per cent. of the above .. .. .. .. .. | 7,000 | 10,000 | 20,000 | 20,000 |
| Replacements and adjustments of stocks (dropped off during slump period, then recovered strongly) .. .. .. .. | 34,000 | 14,000 | 106,000 | 53,000 |
| Total number of baths supplied (in round figures) .. .. .. | 150,000 | 200,000 | 370,000 | 410,000 |

MAP SHOWING THE DISTRIBUTION OF ENAMELLING WORKS THROUGHOUT THE UNITED KINGDOM.

*Foreign Trade.*—The available figures of imports and exports should be considered in relation to the home production. The data for those products which are known to be enamelled show that the main figures for 1934 are:—

| | Production. | Retained imports. | Exports. |
|---|---|---|---|
| Baths, tons .. | 46,700 | 7,739 | 3,639 |
| ,, £ .. .. | 1,328,000 | 195,393 | 115,458 |
| Hollow-ware, tons | 22,500 | 1,678 | 3,499 |
| ,, £ .. | 1,351,000 | 96,565 | 270,557 |

The home market for *all* baths is satisfied by home production to the extent of 85 per cent.; the home market for hollow-ware is met by home production to the extent of 92 per cent.

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### Quantitative Analysis of Principal Materials

Owing to the diversity of products of the industry, this analysis has been made on a broad basis only. The method of obtaining the information has been that of personal inquiry within the different sections of the industry. There is normally no satisfactory check on the information thus obtained, but it is believed to be of considerable accuracy.

The following summary indicates the estimated consumption of enamel batch materials, cast iron, and sheet iron or steel, in the main sections of the industry. Details of the calculations for each section follow the summary.

| Tonnage. | Enamel batch materials. | Cast iron. | Sheet iron or steel. |
|---|---|---|---|
| Baths .. .. | 5,600 | 42,500 | — |
| Gas cookers .. | 4,500 | 37,000 (23,000 not enamelled) | 10,000 |
| Electric cookers .. | 800 | 5,000 (2,000 not enamelled) | 3,000 |
| Hollow-ware .. | 5,200 | 200 | 18,000 |
| Advertising signs .. | 1,900 | — | 4,750 |
| Flat plates, shelves, etc. .. .. | 500 | — | 2,250 |
| Total of above .. | 18,500 | 109,700 | 38,000 |
| Total including 10 per cent. plusage .. | 20,500 | 120,000 | 42,000 |

The last item of 10 per cent. plusage is included to cover a multitude of miscellaneous enamelled goods not in the individual sections of the industry, such as radiators, boilers, ranges, geysers and domestic apparatus, *e.g.*, refrigerators, bathroom equipment. It should also be noted that scrapped finished products and plates wasted in cutting are not included in the separate calculation, and it is, therefore, believed that the 10 per cent. figure is probably a conservative one.

The totals thus obtained from the three chief materials are:—

| | Tons. |
|---|---|
| Enamel batch materials .. .. | 20,500 |
| Cast iron .. .. .. .. | 120,000 |
| Plates .. .. .. .. | 42,000 |

### The Bath Industry

According to the Census of Production and the Import Duties Act Inquiries of 1933 and 1934, the chief figures of production and value are as set out below:—

| | | Tons. | Tons. | Value. £ | Value. £ |
|---|---|---|---|---|---|
| Production of baths— | | | | | |
| Cast iron .. .. .. .. .. | 1924 | — | 17,200 | — | 715,000 |
| ,, .. .. .. .. .. | 1930 | — | 22,400 | — | 657,000 |
| Wrought iron, enamelled .. .. .. | 1933 | — | 41,500 | — | 1,116,000 |
| ,, ,, .. .. .. | 1934 | 35,700 | — | 1,057,000 | — |
| Other kinds.. .. .. .. .. | 1934 | 11,000 | 46,700 | 271,000 | 1,328,000 |

It should be noted that the official description of a bath changed during the period from 1924 to 1934, but it is believed that this change is of no significance. All the production quoted above is described as the output of iron foundries, and it does not include any specialised production such as the manufacture of baths of earthenware. The latter, however, is insignificant in quantity and need not be taken into account.

It is normally assumed that baths weigh about 2 cwts., but it is believed that the figure should be about 2¼ cwts. (including the weight of enamel adhering, which is about 22½ lbs.). Thus the number of the baths made in the census years becomes: 1924, 153,000; 1930, 199,000; 1933, 369,000, and 1934, 415,000.

### Materials

From these production figures the adhering tonnage of enamel can be determined. Allowance is made for 10 per cent. of wastage owing to remelting of spoilt baths, and also 22 per cent. is added to balance the loss in the frit furnace owing to the release of volatile gases. This gives the total consumption of batch materials as:—

| 1934 production. | Tonnage of iron. | Tonnage of enamel batch. |
|---|---|---|
| 415,000 | 42,500 | 5,640 |

### Gas Cookers

It has already been shown that the production of gas cookers is about one million. The average gas cooker contains: 88 lbs. of enamelled castings; 44 lbs. of plain castings; 22¾ lbs. of plates, and a total of 8½ lbs. of adhering enamel.

To the enamel must be added an allowance for the wastage in the spraying booths (some of which is recovered), and, in order to obtain the correct *batch* figures, 22 per cent. must be added for the loss of volatile gases in the frit furnace, and another 5 per cent. must be deducted to make allowance for mill additions, which must be considered separately from the batch materials.

Thus the total figures for this section of the industry become:—

| | |
|---|---|
| Castings (enamelled) .. .. | 40,000 tons. |
| Castings (not enamelled) .. .. | 20,000 ,, |
| Plates .. .. .. .. | 10,000 ,, |
| Batch materials .. .. | 4,850 ,, |

Published statements indicate that of all the gas cookers produced only some 92 per cent. were enamelled in 1935, making the following adjusted figures the final calculations:—

| | |
|---|---|
| Castings (enamelled) .. .. | 37,000 tons. |
| Castings (not enamelled) .. .. | 23,000 ,, |
| Plates .. .. .. .. | 10,000 ,, |
| Batch materials .. .. .. | 4,500 ,, |

### Electric Cookers

For electric cookers it is necessary to work by analogy from the gas cooker figures. The figure of total production of 200,000 given might be split into 150,000 medium and large size cookers, and 50,000 small table cookers and grillers. The industry, however, is small compared with the gas cookers (1 million), and errors of determination are, therefore, relatively unimportant.

It seems probable that the electric cooker is on the average of lighter construction than the gas cooker, and that the proportion of plates is higher. The overall size also is probably smaller on the average.

On the gas cooker basis the weights of castings and plates would be: castings 8,000 tons enamelled, 4,000 tons unenamelled; plates 2,000 tons. On the modified basis these are placed at: castings 5,000 tons enamelled, 2,000 tons unenamelled; plates 3,000 tons.

The medium-sized electric cooker is known to take about 9 lbs. of enamel from the spray gun, 1 lb. of which is recovered. On the basis of 8 lbs. of enamel per cooker, and making the usual adjustments for mill additions and volatile losses in the frit furnace, the tonnage of batch materials becomes 800 tons.

### Hollow-Ware

The details of this industry were made available by the Imports Duty Advisory Inquiry, 1934. The total tonnage shown was 22,500 tons. Hollow-ware is such a miscellaneous collection of products that it is almost impossible to take a reasonable average analysis of finished products. The figures, approximately, are: plates, 18,000; cast iron, 200, and enamel batch materials, 5,200 tons.

### Advertising Signs

Included under the title of advertising signs are sundry flat, multi-coloured, decorated sheets used for such purposes as advertising signs, hearthplates, which in the Inquiry of 1934 are valued at £380,000. One of the firms in this industry has calculated that the quantities involved amount to 1,500 tons adhering enamel and 4,750 tons plates. Correcting for the usual losses, the enamel tonnage becomes 1,900 tons enamel batch materials. It is in this section of the industry that the mill additions include a considerable proportion of colouring oxides.

### Table Tops and Shelves

Two estimates of the quantity and average area are available, namely, 400,000 at 6 sq. ft. each and 500,000 at 5 sq. ft. each. These two estimates are, therefore, in fair agreement as far as square footage is concerned, and for the purposes of further calculation the latter estimate is taken.

Five square feet of sheet contain approximately 2 lbs. of adhering enamel and 10 lbs. of steel plate (of, say, 18 gauge). This gives a total adhering enamel of 1 million lbs., or 450 tons, and a total of 2,250 tons of steel plate. Making the usual adjustments to the enamel tonnage in order to obtain the enamel batch materials figure, this becomes 520 tons. As this figure is based on the higher of two estimates, it may safely be called 500 tons.

### Mill Additions

The manufacture of the slip used for spraying and dipping is carried out in grinding mills. Frit, clay, opacifiers and colours are ground with water. The constitution of the mixture varies considerably for different enamels, but over the whole range it is probably reasonable to assume that 5 per cent. of the enamel batch materials would represent the amount of clay and 5 per cent. the amount of all other additions. Thus, the tonnage of clay is approximately 1,000 tons (an unimportant expense) and the tonnage of other mill additions 1,000 tons, which may represent a very important expense.

The chief opacifier is tin oxide, and with tin at nearly £230 a ton, the tonnage quoted is a burden to the enameller, who turns to materials which are cheaper. Antimony, fluorine compounds, titanium, arsenic and others are all used, and it would seem likely that even cerium is more than a possibility as a new opacifier.

From this report it is now possible for members of the industry to visualise the potentialities for co-operative action in its broadest field and in its sectional interests.

## Publication Received

AS PART OF THE activities undertaken to celebrate their half-century of existence, Sternol, Limited, Royal London House, Finsbury Square, London, E.C.2, have issued an interesting brochure which, in addition to giving an insight into the history of the firm, gives portraits of their executive staff and illustrations of departments of their organisation. We think it would have been a nice gesture to include some pictures of their oldest employees and foremen, because, after all, it requires a wider cross-section of the personnel than has been included to give a true picture of an organisation. We offer our personal congratulations to Sternol, Limited, on having successfully served industry for so long a period as fifty years.

THE BOARD OF TRADE give notice that they will require returns in relation to the year 1937 in respect of the manufacture in the United Kingdom of goods of any class or description which, if they were imported into the United Kingdom, would be chargeable with Customs duty under the Safeguarding of Industries Act, 1921, and the Import Duties Act, 1932, Part I.

# The Grey-Iron Foundry Industry

## By FRED. W. FIRTH (Chairman, Brightside Foundry & Engineering Company, Limited)

THIS attempt to give a general survey of the grey-iron castings industry must be somewhat limited, the industry embracing as it does all types of foundries, from those producing light castings such as rain-water goods weighing only a few pounds or even ounces, to those making engineering castings of a heavy and complicated nature, and castings such as stamp blocks and heavy ingot moulds for the forging trade. The survey, therefore, can only be a cross-sectional view of such work which the author has knowledge of, supplemented largely by information obtained from his colleagues and gathered from replies to a questionnaire sent out by the Editor to a number of representative firms.

The promise of further expansion in trade with which the past year opened has been more than fulfilled. It is estimated that the foundries are working to at least 80 per cent. of their capacity and the employment during the year has increased by about 15 per cent. Reports from individual sections give the following information:—

*Foundries making Castings for the Automobile Trade.*—In almost every case there has been an increase of between 15 and 20 per cent. in the staff employed, and large sums of money are being spent in mechanisation; in one case this was reputed to be of the order of £60,000.

*Builders' Ironfounders.*—These foundries are working at full capacity, and most of them can give good deliveries.

*Marine-Engine Castings.*—These foundries report that whilst the situation has improved, they are still working to only 40 per cent. of capacity, but with a 50 per cent. increase in personnel.

*Textile Foundries.*—These are undoubtedly doing better and are working to about 75 per cent. of capacity.

*Pipe Foundries.*—This industry reports an increase in personnel of about 10 per cent. The three largest foundries have all increased their casting plant during the year, whilst an entirely new spinning plant has been started up on the North-East Coast.

*Jobbing Foundries.*—Small improvement only has been experienced by jobbing foundries, particularly those situated in the country. In general the South seems to be considerably more active than the North, and one at least is undertaking very considerable extensions.

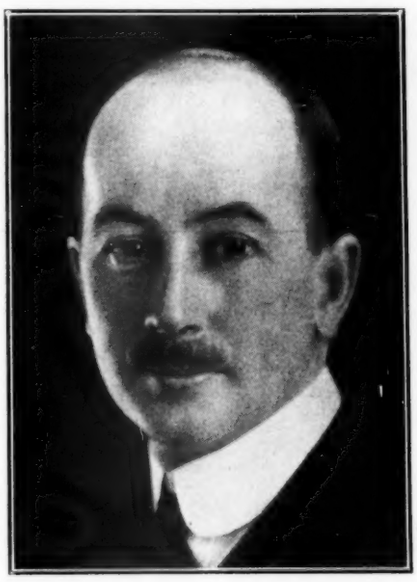
*Baths, Gas and Electric Cookers.*—These three sections of the foundry industry are working to 100 per cent. capacity. There are 1,000,000 gas stoves being manufactured each year, and something like 200,000 electric cookers. One bath foundry in the South of England is said to be producing baths at the rate of 2,000 per week. In recent years this section of the industry has spent large capital sums in order to bring its products in line with modern requirements, especially from an engineering point of view.

*Machine-Tool Foundries.*—Information received from foundries working for the machine-tool trade shows that they are now working at almost 100 per cent. of capacity. Here and there shortage of skilled labour is reported, but several of the foundries are carrying out important extensions involving new buildings.

*Engine Builders.*—Reports from engine builders with their own foundries show that in one case the foundry is two months behind in its deliveries, in spite of the fact that their machine moulding plant has been increased by 25 per cent. They would be pleased to have increased deliveries from their own foundries.

*High-Duty Cast-Iron Foundries.*—Very interesting reports have been received from foundries specialising in high-duty cast iron. Orders have been increased about 20 per cent. Deliveries are now three to four weeks against one to two weeks a year ago. Two foundries report a considerable increase, and all are working at 100 per cent. capacity and are now entering the export market.

*Light Repetition Foundries.*—The foundries engaged on repetition work are also experiencing a boom. One foundry has acquired a licence for a specialised type of high-duty iron and is erecting a special foundry for its manufacture. They also report that they are working to 100 per cent. capacity.



MR. F. W. FIRTH.

*Foundries Working for the Railway Companies.*—This type of foundry seems to be in a reasonably satisfactory position. One reports a 33⅓ per cent. increase in staff and another 40 per cent.; one is working at 92 per cent. capacity, and the other at 100 per cent. Many are carrying out large extensions to their foundries.

During the year there has been considerable activity in the demands for alloyed cast iron, together with special requirements, and much research work has been carried out with a consequent large benefit to the trade.

### Supply of Raw Materials

There is considerable uneasiness among foundries in connection with the continuity of supplies of pig-iron and coke, and some apprehension is expressed at the increase in cost of raw materials. It is hoped that it may be possible to take steps to ensure that abnormal rises in price do not take place. For how long the present state of trade will last is uncertain, but if no serious political upheaval occurs, either in this country or internationally, progress should continue steadily. It is known that world trade has begun to move upwards, and with the rough stabilisation of money values entered into by a number of leading nations, confidence should be restored and foreign trade increased. There is knowledge certainly that Great Britain is always ready and able to take its fair share. To appraise trade prospects, even under present conditions, would necessitate an answer to the following questions:—

(*a*) What proportion of the present increased output is due directly or indirectly to the re-armament programme? From information it would appear that at any rate so far this programme has had very little effect on the iron foundries of this country, with the possible exception of those foundries catering for the machine-tool trade and, of course, the armament-manufacturing firms themselves. It is extremely difficult to estimate its indirect influence. It has been stated that there might be some danger of this armament programme interfering with the normal course of trade development, but it is thought that all armament-manufacturing firms are taking every possible step to avoid any interference with their ordinary trade.

(*b*) How much of this present activity is created by special temporary measures, such as housing schemes and extensions and renewals to plant which have been neglected during the depression years and, once completed, are not likely to occur again to the same extent in the future?

(*c*) To what extent is industry increasing its export trade? It is quite certain that we cannot indefinitely continue to "take in each other's washing." How important a factor this is in any real and permanent recovery was voiced by Mr. McKistry, who said "The people of the British Isles could not support themselves on internal trade, we must make ourselves efficient for catering for the markets of the world, however difficult it might be at the moment." This point was further emphasised recently by the chairman of the Westminster Bank, who said "A nation is no more able to continue indefinitely to buy without selling than is an individual." How much leeway we still have to make up is shown by the following comparative figures giving our exports and imports for 1929 and 1936. The 1936 figures are for twelve months based on the ten months' returns.

| | 1929. £ | 1936. £ | |
|---|---|---|---|
| Imports .. | 1,220,765,300 | 825,762,861 | 68 per cent. of 1929. |
| Exports .. | 729,349,322 | 437,143,214 | 60 per cent. of 1929. |
| Re-exports | 109,701,828 | 59,999,397 | 50 per cent. of 1929. |

Whilst any contribution the grey-iron foundries may make to reduce the 40 per cent. additional exports needed to arrive at the 1929 figures may be small, the question is of some importance in view of the fact that their main market must depend on the prosperity of this country. A well-known steel producer who is also closely connected with the iron trade recently offered some advice to ironfounders in the following words: "Whilst the steel makers would prefer to buy British they must have the most up-to-date plant. If that could not be purchased in this country they were compelled to go abroad." Continuing, he said "We are standing on a better wicket than the foreign competitors at the moment, and it is up to us to make up lost ground and to put ourselves once again into a pre-eminent position as regards invention, research and scientific discovery that

we held formerly." He suggested that it would be wise for the ironfounders to push ahead with research and scientific developments as hard as they could, at the same time making provision for bad times. This advice is worthy of consideration and should lead foundry owners to weigh up their present position in relation to it. For over 30 years the Institute of British Foundrymen has been building up the general metallurgical knowledge of its members, introducing them to new methods of manufacture, and fitting them to fill executive positions with confidence and success, and to investigate a number of essential problems. The recent report dealing with costing should be invaluable, particularly when times become less prosperous, tending to encourage price cutting.

More recently the British Cast Iron Research Association has been of invaluable assistance, and has been enabled, with its fully-trained staff, not only to tackle the original research and keep in touch with the latest metallurgical problems, but to help ironfounders with difficulties arising from time to time.

One of the most striking features during the year has been the growth of mechanised plants. These are, of course, limited to foundries requiring a fairly large output of one or only few types of castings, but as an example of this there is one firm turning out 600 medium-sized boxes per day, or one mould every 45 seconds. Such outputs cause one to reflect upon the tremendous demand for such castings, and make one realise how impossible it is for the foundry not so equipped to compete.

With regard to melting equipment, the success of the "Balanced-Blast" cupola for suitable applications appears to be proved. Evidence of this is afforded by the number of firms who have placed orders after extensive trials. There has also been considerable progress made in the use of the small rotary oil-fired furnace and pulverised-fuel rotating furnaces to produce special iron castings where definite control of temperature is required. This type of furnace has enabled the shortcomings of the cupola, where the iron is subject to contamination by other charges, to be overcome.

Considerable progress has been made in the use of regenerated floor sand. Castings up to 40 tons in weight are now being made with less than 10 per cent. new sand in the mixture. This method shows very considerable saving, not only in new sand but in the disposal of old.

The demand for special irons of the alloy or inoculated type has grown considerably during the year, and many firms have erected new shops and plant to deal with this special type of work. In face of the proposed new physical tests for high-duty iron it would appear that there is great likelihood of a large increase in the number of firms putting down plant to achieve this object.

# The Steel-Foundry Industry

## By C. K. EVERETT (Chairman, Edgar Allen & Company, Limited)

THE steel-casting industry, like all other sections of the steel industry, is benefiting from the increased demands made by practically all sections of the engineering trade. As an example, one may cite the extension of electric traction on railways. This calls for a considerable tonnage of high-permeability steel castings. Again, the increase in metalliferous mining, such as for gold, copper, tin, etc., inevitably calls for extensive supplies of steel castings of every type. An interesting feature in this connection is the increased use of steel castings into the composition of which enter special alloys, and it is fairly safe to say that to-day a larger percentage than ever of manganese steel, nickel-chrome steel, and molybdenum steel castings is being used, especially where resistance to abrasion is required. The development of electric traction on railways has already been referred to, but this is not the only aspect of railway maintenance and progress which involves the employment of steel castings. Railways are continually extending and amplifying their rolling stock, and this alone necessitates the provision of increased supplies of locomotive, wagon, and carriage castings. Many of the smaller castings of this type have to be cast to very fine limits so far as allowances for machining are concerned.

This has been achieved by means of a special process, the advantages of which are the elimination of those machining losses due to the fact that defects are not revealed until the machining operation. In other words, the customer is presented with sound castings which save him the expense of machining work carried out on defective material. Secondly, the castings are true to shape and therefore capable of being jigged, which makes them formidable competitors of cast iron and malleable castings, which have of necessity been previously used owing to the difficulty, if not impossibility, of obtaining steel castings true to shape.

This process is such that only the minimum machining allowance is required, which enables weight to be reduced and machining costs to be lessened. In fact, in some instances a machining allowance has been dispensed with. For example, one may take the brake lever for a main line traction motor on an important English railway. The drawing which the customer supplied for this stated: "Makers to say if it is possible to cast the jaws and slide portions of these parts parallel and smooth. If not, ⅛ in. allowance for machining required." The patterns as received by the steel foundry had a machining allowance provided. This was removed, and four samples were submitted to the customer, who approved of them. Since then hundreds of these castings have been made without any machining allowance at all, thereby dispensing with the necessity for an expensive machining operation by the customer.

MR. C. K. EVERETT.

In another instance, trouble was experienced by an important English railway company in drilling the four holes in the face of a wagon buffer case. By the special process referred to above, the holes were moulded and cast with sufficient accuracy to dispense with the necessity of drilling.

Reference has already been made to the enormous increase in demand for castings. With this has come a continuous improvement of foundry technique, an improvement extending to almost every phase. More attention has been given of late to the preparation of moulding material, and research into moulding sands alone occupies the time and attention of an increased number of experts. Improved moulding machines have been developed and are now available. This, again, has reacted favourably on production methods and output. Considerable progress has been made in mechanisation of layout, and the foundry of to-day is a very much more scientifically organised production unit than that of even 20 years ago.

The rational and perfectly sensible demand of users for cleaner castings has compelled the foundryman to devote a good deal of care to the installation and efficient operation of special processes for producing the desired finish. Shot-blasting has been improved, and the newer cleaning machines of the "Wheelabrator" type are giving very promising results.

In another direction, the call for castings of analyses varying considerably from standard has made great demands on the skill of the melters. In this respect, the high-frequency electric furnace has proved of great value, and the author's firm are proud of the fact that they installed the first furnace of this type to be used for steel manufacture in the world, and now have no fewer than four of these furnaces in constant operation. The great advantage with this type of furnace is not only the purity of the resultant steel, but also the extreme closeness with which melting temperatures can be controlled, and the thorough diffusion of the heavy alloying metals due to the electrical agitation set up in the bath by the eddy currents.

In the early days of the steel-foundry industry, the heat-treatment of steel castings was almost an unknown science, but to-day, with the use of alloy steel castings continually on the increase, a well-equipped heat-treatment department is essential in any foundry, especially where alloy castings are concerned. A department of this type must be equipped with furnaces that can be held at an exact and constant temperature. Furnace builders have provided furnaces of the type required, but these are expensive, and purchasers of alloy steel castings must be prepared to pay reasonable prices for them, and take into consideration the costly equipment and skill necessary for their production. Very little thought will convince the buyer that a foundry possessing equipment of this kind, and giving to these castings the most effective heat-treatment, is the most likely to provide steel castings which will give the desired results in service, and which will not, through failure in use, eventually cost considerably more than the small additional sum constituting the difference between heat-treated castings and those not so treated.

In conclusion, it is a personal conviction that the steel foundries of this country are second to none in the world, either in equipment or in the skill of their personnel. The improved conditions which the increased demand has brought about are a just reward for the tenacity of the foundry industry during the long period of depression recently experienced.

# Development of High-Duty Cast Iron

## By A. B. EVEREST, Ph.D.

LAST year was a year of continuous progress in the development and application of all those types of special and alloyed cast irons which to-day may be classified under the title of "high-duty." This progress has covered not only irons of improved mechanical properties, offering to engineers the possibility of increased stresses, saving in weight, or the replacement of more expensive materials; but also has resulted in castings of improved quality better able to meet satisfactorily the more severe conditions encountered in engineering practice such as those involving heat, corrosion and complicated mechanical stress.

### Research

The development of these more specialised products of the iron foundry and their application to engineering practice naturally demands a fuller knowledge of their properties. In this connection 1936 has been marked by the publication of the results of a number of important researches, some of them aiming to increase the stock of knowledge of the fundamental principles governing the structure and properties of cast iron, and others which throw increased light on to the more abstruse properties of cast iron with special reference to modern high-duty castings. Mention might be made for instance of the important results of investigations into creep, fatigue and impact resistance published during the year, whilst of more fundamental interest is the work published by the British Cast Iron Research Association on the effect of non-metallic inclusions and other influences on the structure of the metal particularly with reference to the size and form of the graphite. Researches of these types all lead to a better understanding of cast iron as a whole and open up new fields for the development of high-duty castings for engineering practice.

### Foundry Control

The production of high-duty cast iron calls for greater control and improved efficiency in melting operations. This is being met by the more careful design of the cupola but also to a greater degree by the development of alternative forms of melting as in the rotary and electric furnaces. These latter types of melting units offer a degree of control over composition which it is doubtful can ever be achieved in the cupola, and they therefore offer special advantages in the production of high-duty castings. A number of rotary furnaces of different types have been installed in the country and are being used for the production of castings of high strength and also for castings containing varying degrees of alloys.

Electric furnaces are also becoming of increasing interest and a number of units consisting principally of the rocking arc type have been installed. These furnaces are employed in the production of high-duty castings, as for the automobile industry. They offer exceptional facilities for control and operate with cheaper charges consisting principally of scrap iron and steel. Electric furnaces of the type mentioned are now in operation for the production of flywheel castings, replacing steel forgings in which case a minimum strength of 20 tons is obtained from an iron made entirely from borings, swarf, and steel punchings. In another case an electric furnace has been installed for the production of the alloy iron known as "Ni-Hard" and after several months' operation it is reported that in this case it is possible to calculate the resulting composition from the ingredients of the charge so accurately as to be within the limits of analytical error. The losses in this case of carbon, chromium and silicon are extremely low and are so constant as to be under absolute control. Other electric furnaces are engaged in the manufacture of piston rings and cylinder liners whilst others are used

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for the production of the more highly alloyed cast irons such as "Ni-Resist" and "Nicrosilal."

### Development of Alloy Cast Irons

During the year a considerable development is to be recorded in the use of alloy cast irons for the production of high-duty castings. The use of nickel for this purpose has now been long

*[By courtesy of Ley's Malleable Castings Company, Limited.*

ROCKING ARC ELECTRIC FURNACE USED IN PRODUCTION OF HIGH-DUTY CAST IRON.

well-established, and by the use of careful melting control and judicious alloying, castings with tensile strengths of 20 tons are regularly produced, whilst where even better properties are demanded the inoculated iron "Ni-Tensyl" is preferred, and strengths up to 25 tons may easily be obtained. In each case a marked further increase in strength can be achieved by heat-treatment as mentioned below. Other alloy additions which are coming increasingly into use are chromium, molybdenum and copper. The best results generally are obtained by a combination of these elements, and for high-duty castings it is not infrequent to find to-day that a suitable grade of base iron is alloyed simultaneously with nickel, chromium and molybdenum. An example of the application of this latter type of iron is to be found in automobile cam- and crank-shafts, increasing interest in which is being taken by the automobile industry where a large number of such shafts are now in successful operation.

The high strength irons such as "Ni-Tensyl" are proving of great interest for heavy castings such as machine frames, winding drums, press dies, large chemical castings, and similar applications. Castings of these types with strengths of 23 to 25 tons per sq. in. are now being used regularly to replace steel castings, or in cases where increased stresses render ordinary cast iron unsuitable. A special feature of the inoculated type of cast iron is its adaptability, it being found to give uniform properties across an unusually wide range of section thicknesses. One manufacturer regularly handling this iron reports that with it he casts from the same ladle of metal small cylinder castings of ¼ in. section and large couplings with sections 6 in. in thickness. The small castings prove readily machinable, whilst in the thick sections the soundness of the metal is better than ever before and no traces of porosity or unsoundness are found.

### Roll Making

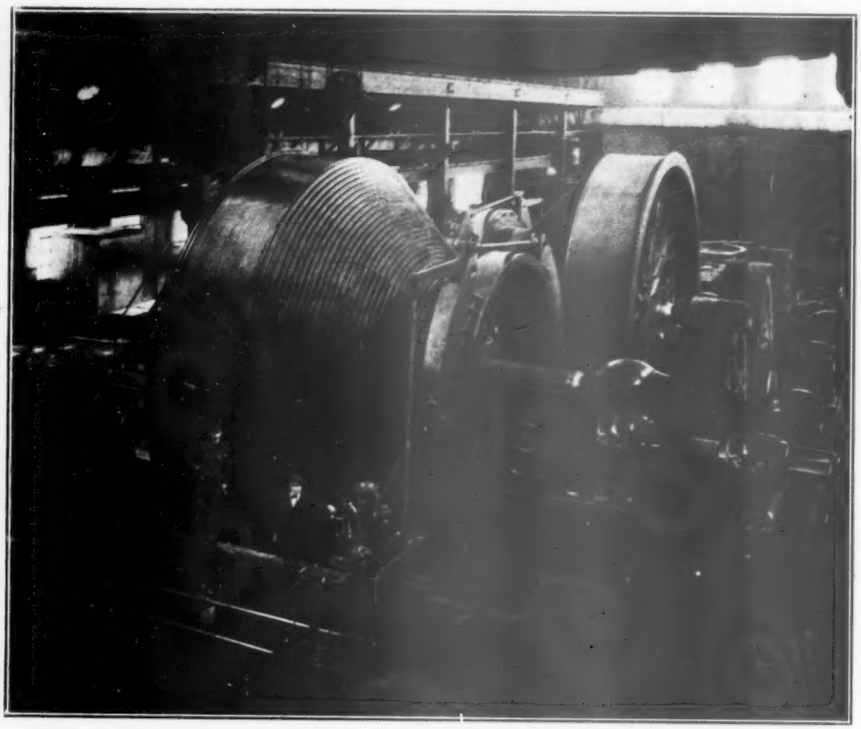
Remarkable developments have taken place in 1936 in the production of cast-iron rolls both of the chilled and grain types. "Ni-Hard," which is an alloyed white or chilled iron of very high hardness, is being used increasingly for chilled rolls, even replacing hardened steel. In softer grades of rolls, however, nickel, chromium and molybdenum are being increasingly used, and roll founders are now able to offer rolls of improved strength, wearing quality and better service performance generally for almost any set of conditions. "Ni-Hard" is also being increasingly used for general engineering applications where severe abrasion is encountered, as, for example, in sand handling and in many mining applications.

### "Meehanite"

Amongst the special process irons "Meehanite" to-day holds an important place in the industry of this country. The International Meehanite Metal Company, Limited, report that the past year has been one of remarkable progress for them, both with regard to the tonnage produced and the extension of the fields of application in which "Meehanite" metal has successfully been used, and to-day some twenty distinct grades of "Meehanite" are available, each of which has been developed for some particular type of application. Among the outstanding new applications of "Meehanite" are those in which the metal is used to replace steel either as castings, forgings or machine blanks. "Meehanite" also is being used experimentally for automobile crankshafts, and it is reported that the results of bench and road tests have been so satisfactory that a prominent automobile manufacturer has placed an order for 500 crankshafts for immediate use.

"Meehanite" is being used to an increasing extent for dies, especially for the forming of bakelite and moulded rubber products. The

range of castings made in "Meehanite" during the year extends from some of the lightest and most delicate stove plate work, through automobile and Diesel engines and heavy machine tools and some of the largest hydraulic pressure valves made in this country, to heavy turbine castings. During the year the Meehanite Research Institute has been formed, leading to the closer co-operation among the licensees for the development of "Meehanite" to meet the ever-increasing demands of industry.



[*By courtesy of Canadian Allis-Chalmers, Limited.*

A 400-TON MINE HOIST RECENTLY INSTALLED AT THE CREIGHTON MINE OF THE INTERNATIONAL NICKEL COMPANY.

### Heat-Treatment

The heat-treatment of iron castings to improve such mechanical properties as hardness, strength and wearing quality is being increasingly applied to high-duty castings as for the automobile industry. This development, as in the case of steels, followed the use of alloys, and the value of nickel to give uniformity, strength and depth-hardening characteristics, of chromium to control the carbides present in the casting and of molybdenum to give further improvement in mechanical properties is to-day fully appreciated by industry. Heat-treatment is now widely used for parts subject to wear, such as cylinder liners, gear wheels, cams and small dies, in all of which a high degree of hardness, toughness and wearing quality may be developed after the casting has been machined. It is also applied in many other cases, such as crankshafts and other highly stressed parts where the maximum strength is desired in addition to good wearing quality and other properties. The improvement in strength obtainable by heat-treatment may be as much as 30 per cent. over that obtained in the initial casting, so that when applied to a high-duty iron the resulting strength is frequently between 30 and 40 tons per sq. in.

### Corrosion- and Heat-Resisting Cast Irons

Steady progress has been made during 1936 with the more highly alloyed corrosion- and heat-resisting cast irons. The well-known iron "Ni-Resist" has been in constant use throughout the year in the form of pump impellers in the King George V Graving Dock at Southampton and, as a result of the experience gained in this application, the pump makers have not hesitated to use the same alloy iron in the construction of the high-duty pumps operating the new train-ferry dock at Dover. Other applications of "Ni-Resist," "Nicrosilal" and the other special high-alloy irons include castings for the chemical industry, furnace parts and so on.

A development of outstanding interest in connection with corrosion-resisting cast irons in 1936 is their application on a commercial scale to cylinder liners for automobiles. Some two or three years ago the Institution of Automobile Engineers evolved the theory that cylinder wear, particularly under cold engine conditions, was partly of a corrosive nature. This theory naturally pointed to the use of corrosion-resisting irons for use under such engine conditions, and it is now known that some users of commercial vehicles operating on short runs, some of the railway companies operating mechanically-propelled vehicles in their goods yards, and even some of the operators of public-service vehicles have now, as a result of successful trials, standardised on austenitic cylinder liners throughout their fleets.

### Conclusion

In the past ten years a great deal of time and money has been spent on research and development in connection with high-duty and alloy cast irons of all types. A review of 1936 shows unmistakable evidence that industry is now accepting to an increasing extent the results of this research and is in a position to-day to supply the engineer better than ever before with the castings he requires for high-duty and specially severe applications. The development of high-duty cast irons is in a very strong position, and foundrymen can look forward to 1937 with increased confidence that the market for high-duty irons will continue its rapid advance.

# The Foundry Scrap Market in 1936

THE increased trade throughout the engineering works and foundries has again brought to the forefront the very important relationship of cast-iron scrap and foundry pig-irons.

In pre-war days the price of first-class machinery cast-iron scrap usually stood very near to that of No. 3 foundry pig-iron, but after the war and during the slump period, owing to the large tonnage of obsolete and redundant plant and machinery coming into the market for scrapping, the price of the two commodities drifted apart, so that the variation in certain cases reached about 25s. per ton. The prices offered by ironfounders were so low that the scrap merchants and dismantlers found it impossible to go to the expense of breaking plant into small pieces for cupola use, and considerable quantities were diverted to the steelworks in large pieces for use in Siemens furnaces, thus reflecting a considerable saving in the dismantlers' and breakers' costs. Certain foreign countries took advantage of the low prices ruling for scrap, and substantial quantities were shipped to Italy, Spain, Germany, etc.

A few ironfounders in the country, realising the saving that could be effected by using a larger proportion of scrap in the cupola charge, conducted experiments, and eventually in some cases succeeded in operating with up to 90 per cent. of scrap and 10 per cent. of pig-iron.

The difficulties of obtaining deliveries of certain grades of pig-iron, at present, are again influencing the cast-iron scrap market, and prices tend to regain a basis nearer the proper value as compared to pig-iron, although to-day the margin of difference in the two prices is approximately 10s. per ton. It seems probable that with the recent further advances in the pig-iron price, foundry managers may consider the question of the proportion of scrap to be used in a charge to be worthy of special consideration. Reputable scrap merchants to-day sort and grade all scrap carefully, and the risks caused through the inclusion of light, burnt, and hard metal are now almost eliminated.

# Iron and Steel Production

The British Iron and Steel Federation reports that there were 110 furnaces in blast in the United Kingdom at the end of December, six furnaces having ceased production (two of which are temporarily damped down) and two have been blown in during the month. The production of pig-iron in December amounted to 671,400 tons, compared with 643,100 tons in November, and 559,300 tons in December, 1935: the month's production includes 165,800 tons of hematite, 357,200 tons of basic, 121,000 tons of foundry, and 13,100 tons of forge pig-iron. The total production of pig-iron for 1936 amounted to 7,685,700 tons compared with 6,424,100 tons in 1935, an increase of 19.6 per cent. The monthly average in 1936 of 640,500 tons compares with 632,400 tons in 1929 and 855,000 tons in 1913.

The production of steel ingots and castings in December amounted to 1,019,200 tons, compared with 1,001,300 tons in November, and 811,500 tons in December, 1935. The total production for 1936 amounted to 11,698,200 tons, compared with 9,858,700 tons in 1935, an increase of 18.7 per cent.

# The Pig-Iron Industry

## By E. J. FOX (Managing Director, The Stanton Ironworks Company, Limited)

THE recent activity in the iron and steel trades has realised even optimistic expectations. Production records have been established, confidence has been restored, and with a continuance of cheap money facilitating a flow of fresh capital, the industry has been placed on a sound basis.

This revival and expansion is primarily the result of improved conditions in the domestic market. Productive capacity, although considerably enlarged, has lagged to some extent behind an insistent demand. The activity in the home market can be attributed largely to increased confidence, the heavy requirements of the motor-car industry, the building and allied trades—all large users of steel and pig-iron—and, to an extent, the Government's rearmament programme

*Production of Foundry Iron in the United Kingdom, showing Tonnage and Percentage of Total Pig-Iron Production in each year from 1930 to 1936.*

| Year. | Output. | Percentage of total pig-iron. |
|---|---|---|
| | Tons. | Per cent. |
| 1930 .. .. .. | 1,433,600 | 23.1 |
| 1931 .. .. .. | 1,153,600 | 30.6 |
| 1932 .. .. .. | 1,020,100 | 28.5 |
| 1933 .. .. .. | 929,100 | 22.5 |
| 1934 .. .. .. | 1,275,500 | 21.3 |
| 1935 .. .. .. | 1,325,800 | 22.6 |
| 1936 .. .. .. | 1,311,700 | 17.1 |

### Pig-Iron Prices

Table I shows recent fluctuations in the price of No. 3 foundry pig-iron delivered into the Birmingham district, as quoted by the Central Pig-Iron Producers' Association.

TABLE I.—*Price of No. 3 Foundry Pig-Iron Delivered to the Birmingham District.*

| | Class I P 0.75 to 1.00 per cent. | Class II P 1.00 to 1.50 per cent. | Class III P over 1.50 per cent. |
|---|---|---|---|
| | s. d. | s. d. | s. d. |
| 1935 average .. | 72 2 | 71 8 | 68 4 |
| 1936 average .. | 80 6 | 78 0 | 75 6 |
| 1936— | | | |
| January .. .. | 77 6 | 75 0 | 72 6 |
| February .. .. | 77 6 | 75 0 | 72 6 |
| March .. .. | 77 6 | 75 0 | 72 6 |
| April .. .. | 77 6 | 75 0 | 72 6 |
| May .. .. | 77 6 | 75 0 | 72 6 |
| June .. .. | 77 6 | 75 0 | 72 6 |
| July .. .. | 82 6 | 80 0 | 77 6 |
| August .. .. | 82 6 | 80 0 | 77 6 |
| September .. | 82 6 | 80 0 | 77 6 |
| October .. .. | 82 6 | 80 0 | 77 6 |
| November .. | 82 6 | 80 0 | 77 6 |
| December .. | 88 6 | 86 0 | 83 6 |

### Production Costs

Any reduction in costs as a result of the expansion in output, plus the extension and modernisation of plant, has been offset, however, by increased prices for raw material.

*Imports of Forge and Foundry Pig-Iron into the United Kingdom for the last Five Years.*

| Year. | Tons. |
|---|---|
| 1932 .. .. .. .. .. .. | 30,107 |
| 1933 .. .. .. .. .. .. | 37,693 |
| 1934 .. .. .. .. .. .. | 110,203 |
| 1935 .. .. .. .. .. .. | 67,431 |
| 1936 (estimated) .. .. .. .. | 41,900 |

The ironmasters, maintaining their policy of co-operation, and recognising the necessity for fostering an increased demand, have not increased prices to balance the higher cost of raw materials. Profits certainly have not been commensurate with increased outputs.

The price of furnace coke alone, for instance, has risen since 1935 by approximately six shillings per ton, and higher prices are now being asked for 1937.

MR. E. J. FOX.

### Pig-Iron Production

The following table shows the position of the United Kingdom pig-iron production for the years 1913, 1920, 1929, and 1933 to 1936.

| | Tons |
|---|---|
| 1913—Monthly average .. .. | 855,000 |
| 1920— ,, ,, .. .. | 669,500 |
| 1929— ,, ,, .. .. | 632,400 |
| 1933— ,, ,, .. .. | 344,700 |
| 1934— ,, ,, .. .. | 497,400 |
| 1935— ,, ,, .. .. | 535,500 |
| 1936—January .. .. .. | 595,500 |
| February .. .. .. | 584,700 |
| March .. .. .. .. | 633,600 |
| April .. .. .. .. | 629,800 |
| May .. .. .. .. | 661,000 |
| June .. .. .. .. | 644,100 |
| July .. .. .. .. | 665,600 |
| August .. .. .. .. | 635,800 |
| September .. .. .. | 650,800 |
| October .. .. .. .. | 670,300 |
| November .. .. .. | 643,100 |
| December .. .. .. | 671,400 |

It is estimated that deliveries of foundry pig-iron during 1936 will represent an increase on 1935 of 20 per cent.

### Steel Scrap

The production of pig-iron for foundry purposes—if one excludes a limited number of undertakings permanently confined to foundry-iron production—is influenced fundamentally by the demand for basic pig-iron from steel manufacturers. This demand, in its turn, is largely dominated by the price and available supply of scrap for steelmaking.

A steel mixture to-day comprises an average of 50 per cent. scrap. It will be seen that a 10 per cent. variation in the charge, on a steel output of 1,000,000 tons per month, releases a potential demand for an additional 100,000 tons of basic pig-iron. The effect is the transfer of blast furnaces from the production of foundry grades to basic.

Early in 1936 this position was evident and threatened to control the whole policy of foundry pig-iron production, but was relieved by temporary importations of both scrap and basic pig-iron from foreign countries.

It should not be overlooked that, whilst the cost of pig-iron can be controlled to some extent, steelmakers are almost entirely dependent on a free market for supplies of scrap. In other words, production costs of steel can be considerably influenced by this factor.

*Monthly Production of Foundry Pig-Iron in the United Kingdom during 1936.*

| Month. | Tons. |
|---|---|
| January .. .. .. .. .. | 105,100 |
| February .. .. .. .. .. | 92,900 |
| March .. .. .. .. .. | 106,000 |
| April .. .. .. .. .. .. | 94,800 |
| May .. .. .. .. .. .. | 123,500 |
| June .. .. .. .. .. .. | 109,800 |
| July .. .. .. .. .. .. | 103,700 |
| August .. .. .. .. .. | 117,100 |
| September .. .. .. .. .. | 108,100 |
| October .. .. .. .. .. | 113,200 |
| November .. .. .. .. .. | 116,500 |
| December .. .. .. .. .. | 121,000 |

It is not easy to estimate the future relationship between basic pig-iron and scrap in the production of steel, but, in many quarters, it is considered that an adequate supply of steel scrap below the cost of pig-iron is essential for the maintenance of the export markets for finished steel products.

### Light Castings Trade

A considerable increase in the consumption of foundry pig-iron for the light-castings industry has been experienced. This is primarily as a result of the initiative and progressive development of that branch of the trade. Cast iron has many advantages, particularly for purposes such as domestic fittings, the gas and electrical industries, heating appliances, etc., and assisted by improved technique in the use of the vitreous enamelling process, the demand gives every indication of further expansion.

### Heavy Engineering

The one section of the industry that did not perhaps share to the same extent in the better conditions prevailing is the textile machinery and heavy engineering trade. In the second half of the year, however, the outlet for special grades of iron for such purposes perceptibly increased, and now appears to be well established.

### Steel Stampings

Side by side with an increasing demand for steel, the consumption of foundry and forge pig-iron is likely to extend; but it should not be overlooked that great progress has recently been achieved in the field of steel stampings and pressings—to say nothing of fabricated steel by welding—which must eventually have some bearing on the consumption of foundry pig-iron.

*Exports of Forge and Foundry Pig-Iron from the United Kingdom for the last Five Years.*

| Year. | Tons. |
|---|---|
| 1932 .. .. .. .. .. .. | 73,462 |
| 1933 .. .. .. .. .. .. | 54,029 |
| 1934 .. .. .. .. .. .. | 74,533 |
| 1935 .. .. .. .. .. .. | 92,728 |
| 1936 .. .. .. .. .. .. | 57,529 |

### Standardisation of Raw Materials

The British Cast Iron Research Association and the Institute of British Foundrymen have

(*Continued on page* 48.)

# Foundry Equipment and Supplies

## By G. T. LUNT (President, Foundry Trades' Equipment and Supplies Association, Limited)

THE year which has just closed has brought increased activity to all sections of the foundry industry, including those trades supplying plant and raw materials. Present conditions are almost those of a trade boom, with a scarcity of supplies in some directions and substantial increase in prices.

In the raw materials section, some commodities, such as pig-iron, coke and scrap, have for years been sold at unremunerative prices, and higher values were inevitable. The advances which have so far taken place have done little more than to cover the higher costs of production, and control is being exercised to ensure that the consumer is not exploited.

The foundry plant and equipment makers have had a busy year, and it is pleasing to know that the British manufacturers are strengthening their hold on the home market. While this has been brought about to some extent by the introduction of tariffs, it is also true to say that British machines and furnaces have been substantially improved, both in design and effectiveness.

Many improvements and developments in foundry plant have taken place during the year, but probably the two sections in which the most progress has been made are sand preparation and the abrasive cleaning of castings. In connection with the latter, the airless method of fettling is making quick progress, and several proprietary machines are available which claim to effect substantial savings in time and costs. Incidentally, this type of cleaning apparatus would appear to be badly in need of a name to distinguish it from other types of sand- and shot-blasting apparatus (Perhaps the Editor could be persuaded to give the matter some thought.) These airless blasting machines use chilled shot or grit exclusively as a cleaning medium, and it has been claimed that their efficiency and cheap operating costs are due, in some measure, to this fact.

Some of the newer types of melting furnaces have advanced in popularity. Among them the electric furnace is deserving of mention, as it is likely to become in general use for the melting of high-duty cast irons. Many installations of rotary furnaces, of both oil and pulverised-fuel types, have been made, and there are indications that these furnaces may yet be developed sufficiently for the economic production of steel. In spite of these developments, it is true to say that the cupola is still the most popular melting unit, and is likely to remain in general use.

MR. G. T. LUNT.

Evidence that a close study of cupola working will pay for itself in operating costs and quality of metal is afforded by the formidable list of installations of the "Balanced Blast" type of cupola under the auspices of the British Cast Iron Research Association.

Core-making is becoming of ever greater importance, and complete jobs, such as the alloyed crankcase, are entirely built up from cores. A variety of machines for blowing cores, and stoves for economical drying, are available, and several foundries have now installed completely mechanised core shops.

General foundry mechanisation is being accelerated, and in some foundries the system is necessary to cope with the greater volume of output required from the limited space available. Not the least of the benefits to be derived from these installations is the cleaner and healthier working conditions which are brought about.

Mention has already been made of several of the foundry raw materials, including chilled shot for fettling, which is rapidly taking the place of sand both on economical grounds and on the score of health. Among other materials worthy of mention are colloidal clays, the use of which is increasing; refractory bricks and cement, which are undoubtedly improving in quality; coal-dust and blackings, which are now prepared scientifically and sold to rigid specifications, and a new process of using cement-bonded sand. This process is now in regular use on a large scale at a new foundry at Penistone.

During the past year an event of major importance was the International Foundry Exhibition at Düsseldorf, although it is true to say that most of the exhibits were of German origin. This year will bring the staging of another Foundry Exhibition at Olympia, London. It will again be organised by Mr. Kenneth Bridges, and be held in September in conjunction with the Engineering and Machinery Exhibition. Advance information indicates that a very comprehensive list of exhibits will be on view, which will well repay a visit not only from proprietors and managers of foundries, but also from charge hands, moulders and foundry workers generally. The suggestion is made to those responsible for controlling foundries that the organisation of day trips to the Exhibition for their workmen would be inexpensive, and would be well repaid by knowledge acquired and in added zeal and interest.

## The Pig-Iron Industry

(*Continued from page 47.*)

been giving careful attention to the standardisation of raw materials. To give one example, the following revised tolerances in analysis limits for foundry and refined pig-iron have been issued:—

| | Foundry pig-iron. Per cent. | Refined irons. Per cent. |
|---|---|---|
| Total carbon .. | ±5 | ±4 |
| Silicon— | | |
| Up to 4 per cent. .. | ±0.25 actual | ±0.125 actual |
| 4 to 5 per cent. .. | ±0.5 actual | ±0.25 actual |
| Manganese— | | |
| Up to 1.25 per cent. | ±20 | — |
| Over 1.25 per cent. | ±15 | — |
| Up to 0.5 per cent. | — | ±15 |
| Over 0.5 per cent. | — | ±12½ |
| Phosphorus .. .. | ±10 | ±7½ |
| Sulphur— | | |
| Up to 0.05 per cent. | ±20 | ±12½ |
| Over 0.05 per cent. | ±12½ | — |

The main change in these tolerances is the substitution of actual figure variation in silicon for percentage variation, but such limits have now been in practice for some time by the majority of pig-iron producers.

### Fracture and Analysis

Demands made on the ironmaster become ever more difficult and exacting. A recent tendency on the part of pig-iron users has been to combine the question of fracture with analysis, in an endeavour to satisfy the increasingly stringent requirements of modern engineering. Alloy additions to the molten metal, such as nickel, chromium, or titanium, have been still further developed. This increasing use of scientific methods in the production of cast iron, combined with lower costs of manufacture, will favourably influence the future demand.

### Future Outlook

Whilst it must be admitted that prospects on the home market are more favourable than abroad, it is to be hoped that the barriers and restrictions which have so disastrously fettered overseas markets will be swept away to some extent by the three-power currency agreement.

A revival in the trade of the world must provide additional opportunities for extension and expansion, and, having already attained some measure of prosperity in the home market, it is thought that the iron and steel trades can look forward to 1937 as another year of progress.

## Dunswart Iron and Steel Works

Presiding at the annual meeting of the Dunswart Iron and Steel Works, Limited, held in Johannesburg on December 30, Mr. J. K. Eaton, the chairman, gave an optimistic account of the company's activities and future prospects. The net profit for the year ending June 30, 1936, amounted, he said, to £34,970 giving with the amount brought in a balance of £82,031. During the year under review a third electric furnace was completed and the two old furnaces were rebuilt and located so as to give a much improved layout and a straight flow through the foundry. The company could now claim to possess the largest and best equipped electric steel-smelting plant in the Union. Notwithstanding the fact that the three furnaces were only operating during part of the year there was an increase of over 3,000 tons in the quantity of molten steel produced. The plant was to be further extended and the necessary capital was already available for that purpose.

# The Malleable Cast Iron Industry

## By F. D. LEY (General Manager and Director, Ley's Malleable Castings Company, Limited)

THE past year has more than justified the optimistic feeling that existed in the malleable casting industry at the beginning of the year, and the volume of orders has been exceptionally satisfactory, almost all trades showing an improvement. Agricultural implement manufacturers have had a busy year, which has resulted in the malleable foundries receiving the benefit of more orders. The demand for castings for use in electrical products has been well maintained and has been helped by the equipment which is being erected by leading British firms in countries abroad.

Castings coming under the classification of general engineering have increased considerably, and with the general improvement in trade the prospects of the demand for these castings is distinctly promising. The motor trade has continued at a high rate of production steadily throughout the year, and has been assisted by the recent campaign to encourage the public to buy cars made in the United Kingdom.

There has been a general improvement in the demand for malleable castings for pipe fittings, and foundries specialising in this type of casting have been busy. Unfortunately, the tonnage of castings used by the railways still remains extraordinarily low considering the advantages of malleable iron and the quantities used so successfully on rolling stock in the United States of America. The recent improvement in the shipbuilding trade has had its beneficial effect.

On the whole malleable foundries have not been greatly affected by armaments, but there is a general repercussion which has been beneficial.

Very little malleable cast iron is exported in the form of loose castings, but it is used to form parts for motor cars, radiators, agricultural machines, and for these export prospects are good. The result has been that on the average foundries have increased their personnel about 10 per cent., and extensions have been undertaken in several plants.

The excellent properties of first-class malleable iron are being realised more fully by engineers, who find that it is an economical material to use and satisfactory for replacing stampings and fabricated steel. This trend is further stimulated by the advantages of price and the quicker delivery position of malleable iron.

Notwithstanding the increase in demand, competition is still very keen, and foundries are looking for their profits from a larger volume in their plant, as prices have not advanced as much as is warranted by the increased costs of raw materials and wages advances.

### Raw Material Situation

The price of malleable casting raw material, pig-iron, has risen substantially during the past year, and in addition, owing to the demand for hematite, much trouble has been experienced in obtaining prompt delivery. Unfortunately, owing to the civil war in Spain, blast furnaces have not been able to obtain regular supplies of the necessary ores. Foundries have found that, although they have taken steps to give several months' notice of their requirements to the blast furnaces, not only have delivery dates been exceeded but the material has not been available in the required analysis. It is sincerely hoped that in spite of the difficulties with which they have to contend, the blast furnaces will be able to keep prices steady and make the necessary arrangements to meet the delivery dates.

Other materials, such as coal, coke, refractories, moulding sand, core-making materials and annealing cans, have gone up in price and increased the foundries' production costs, although the deliveries have been more satisfactory than in the case of pig-iron. In addition, during the last twelve months wages have been advanced by an increase in the war bonus.

### Labour Shortage

There is now a general shortage in labour, as there is no unemployment amongst suitable malleable iron moulders, and foundries are only able to increase their personnel by training unskilled men. Close attention will have to be paid to this important problem in the future, as, with the increase in machine moulding, skilled jobbing moulders will become even more scarce.

MR. F. D. LEY.

There have been no remarkable developments in equipment during the past year, but the airless shot-blasting machines have proved that the anticipated economies are fully up to expectation, and that they can clean both hard and annealed castings very satisfactorily. There have been several additions in the types of core-blowing machines on the market, and there is no doubt they have a wide field of use; even complicated cores can be successfully blown out by them. Rotary furnaces of several types are regularly being used, chiefly because of the ease of analytical control, but there is still some doubt as to the most suitable lining material, and there appears to be plenty of scope for a more economical refractory.

### Quick-Anneal Malleable

Experiments are still being carried out on methods of quick anneal, and whilst small batches of castings can be successfully treated, the normal cycle is more suitable for producing bulk supplies economically and of first-class quality.

Foundries are realising the importance of sand conditioning, and are finding that modern plant gives a great improvement in quality of sand, and that sand control can exploit this to the best advantage. This control results in a better skin on the casting and a reduction of foundry troubles. At the same time, finishing processes are receiving more attention, so that cleaner and more accurate castings are being produced.

There is now a general tendency for users of malleable castings to co-operate with the foundries, both in designing their castings and in production of patterns. This has proved to be a great advantage, as the customer obtains a cheaper and better casting and the foundry is able to produce it by the most economical method.

### Welfare Supervision

Many foundries are finding it worth while to keep in close touch with the Factory Inspector, and to study Home Office regulations, with the result that greater attention is paid to the lighting, ventilation and heating of shops, and by the installation of new plant for dust removal, the health of the worker is safeguarded. Much success has resulted from advising moulders to wear moleskin trousers with special foundry boots, and the decrease in the number of accidental burns which this precaution has led to has been most encouraging.

### Prospects for 1937

The industry can look forward to the ensuing year with confidence that the amount of business available will continue to be satisfactory, although the rise in cost of production, and the difficulties in obtaining supplies of raw materials will require careful attention. Provided the international situation does not develop unexpectedly, prospects are now equally bright as at the beginning of 1936.

When considering the international situation, it is interesting to note the assistance the malleable industry has given towards building up the nation's defences, not only in material, but also men. One foundry reports that over 100 of their men belong to the Territorial Army and regularly attend a full fortnight's training in camp each year, and that by careful organisation this exodus to camp can take place without adversely affecting foundry production. The improvement in the men's health due to the open air life, and the importance of the Territorials to the country deserve every encouragement being given by foundry executives to their employees to join their local units.

## Publication Received

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We have to confess that this is the first time that we have ever had the opportunity of perusing this house organ. It emulates the general run of Stanton publicity by giving full prominence to the officials—a factor which we appreciate. After all, the recognition of the good work done by the staff is worth much more than a formal vote of thanks proposed by the chairman at the annual meeting of the shareholders. This issue contains an article of a general character on pig-iron, written by Mr. N. L. Goodchild. The digest of American literature is well chosen. Apart from a short story, the balance of the magazine is, as it should be, devoted to the internal matters of the company.

# The Nickel Industry

## By ROBERT C. STANLEY (President, International Nickel Company of Canada, Limited)

STATISTICS for the first ten months of 1936 indicate that the complete year will establish new records for the nickel industry in the volume and diversification of world consumption. Because of the increase which has steadily maintained in the demand for nickel since the low point in 1932, important additions to productive capacity were made during the year in Canada, the United Kingdom, the United States and elsewhere. These additions, which both effected a better balance in production processes and added to potential output, provide the industry with the reserve capacity to maintain prompt deliveries under any conditions which can reasonably be anticipated. They affect the mines, smelters, refineries and merchant mills.

World consumption of nickel in all forms during the first ten months of last year attained a total of some 72,300 tons, an increase of more than 20 per cent. over the corresponding figure in 1935, which had established a new record for the industry. This consumption compares with 50,000 tons in the first ten months of 1929.

Whereas a factor in the 1935 increase in consumption was the policy of industry to restore its stocks to normal proportions in anticipation of better business, analysis of world consumption indicates that the replenishment of reserves had been generally accomplished by the end of 1935, and that nickel had been going last year directly into an industrial world whose production was moving at a definitely accelerated pace. Indicative of this trend is the increase in the number and volume of sales through retail channels in the United States and Canada. Business through American warehouses is expected to total 7,200 tons, or roughly one-fifth of the country's consumption of nickel in all forms and through all channels of distribution.

The detailed review which follows illustrates the sound growth of the nickel industry, but one may mention here the recent histories of the stainless steels, the nickel alloy cast irons and such non-ferrous alloys as Monel and 70/30 cupro-nickel. They have won places in industry, which are synonymous with the special problems of performance that they solve.

Thanks to the new spirit which encourages interchange of scientific and technical information and experience, applications successfully proved in one country soon are adopted in other industrial centres. Thus electric heaters, irons, toasters, percolators and ranges are entering British homes, and electric furnaces are being introduced into British plants for many processes previously served by coal or gas, now that the development of the electrical grid system has made electricity available in all parts of the United Kingdom. And wherever an electrical heating element enters the household or the industrial picture, nickel is almost certain to be an important constituent.

### Political Influences

Although political and economic developments in Europe inevitably affected the nickel industry, consumption of the metal continued to increase. The sanctions which obtained against Italy for the major part of the year and the German policy restricting importations of raw materials to minimum requirements naturally operated to reduce the volume. Yet these adverse conditions were more than offset by the trend, which has become pronounced especially in Great Britain, towards a wider use of nickel-bearing alloys in the broad fields of industry and engineering.

The rapid progress in plant design and equipment made recently in England and in other parts of Europe gives definite promise for the future. Metallurgical works in Sweden are rapidly taking a place among the most efficient in Europe as regards methods, plant and technique. The British non-ferrous industries also have improved their plant and equipment during the last two or three years, as is evident in the new rolling mills, wire and tube drawing benches and particularly in extrusion presses. These advances are an important factor in the development of nickel and its alloys, as no element in industrial use stands to benefit more from improved production facilities for semi-manufactured goods than does nickel.

### Research Programmes

An interesting development in Great Britain during recent years has been the increased expenditure on industrial research, not only in the plants of individual firms, but also through joint effort by sections of industry. Of significance to the nickel industry are the central organisations for research, which have been set up by the steel, cast-iron, non-ferrous and automobile groups. Each of these has become responsible for wide programmes of research both in their own laboratories and in various other research establishments throughout the country. The nickel industry is giving this movement full co-operation, because not only are these organisations developing much useful information regarding nickel-bearing materials, but their investigations of technical problems can only result in good to industry generally.

The Mond Nickel Company's new laboratory at Birmingham is one of the largest in Europe to be maintained by a single firm solely for metallurgical research. With a similar laboratory at Bayonne, New Jersey, and with the one now under construction at Copper Cliff, Ontario, it provides the nickel industry with comprehensive and well integrated facilities for the study of metals and alloys.

### Steel Industry

The steel industry, which is the dominant consumer of nickel, broadened its markets during the year, and in consequence substantially increased the use of nickel alloy steels. New compositions of nickel alloy steels in the form of sheets, plates and other rolled products for structural purposes, not available heretofore, are now being marketed in considerable tonnages under a long list of trade names. Of low alloy content and low cost, these products offer improved corrosion resistance and better physical properties, which have led to their use in the construction of railway goods-wagon bodies and other equipment where light weight and improved performance are desired. The general acceptance of these newer steels has already been reflected in the increased consumption of nickel in this field.

Of interest have been the advances made in the stainless-steel industry during the past year. Not only is more nickel being used, but the standards of quality of finished sheet and strip produced by the principal manufacturers are being raised steadily. In addition to these two conventional products in the stainless-steel series of alloys there is a marked increase in the output of wire and tubes, and the production of special alloy compositions suitable for machining has further expanded consumption.

Progress in this section of the nickel-consuming industries has definitely broadened its base. It is perhaps more obvious in Great Britain than in other European countries, and it is worthy of note that Sweden has made rapid advances. The expanding use of the stainless steels has been noticeable in France as well, and in Belgium the increased interest taken in these nickel-bearing alloys is reflected in their use in important bridge and dam construction.

Although business in France has shown only a moderate improvement, the consumption of nickel increased by about 70 per cent. Much of this gain was reflected in the steel industry, where production of steel ingots and castings increased only 5 per cent. in the first nine months of the year, while the amount of nickel used by this industry doubled. In addition to the nickel steels which went into motor car production and mine equipment, stainless steels were used more largely than ever before in the food and textile industries, in the building of light weight railcars, in the construction of sixty new garages for the Paris bus system and in the replacement of the traditional wooden newspaper kiosks.

### Nickel Plating

Any review of the advances made in European consumption of nickel must include nickel plating. As consumers of metallic products have become accustomed to the idea of corrosion resisting materials and surfaces, the demand for plated finishes has grown. The increased use of these finishes has been especially noteworthy during the last two years, and it is now recognised that a high grade of chromium plating cannot be produced without an appreciable underlay of nickel.

In Great Britain particularly the standards governing nickel-plated deposits have been improved appreciably, due in large measure to the research work which is being conducted under the auspices of the British Non-Ferrous Metals Research Association. The result is reflected in the 40 per cent. increase in the sale of nickel anodes during 1936 as compared with 1933. In France the comparable increase was 20 per cent.

Consumption of nickel in plating is being stimulated further by the advent of bright plating. While still in the early stages of application in the United Kingdom and in Europe generally, the process is making substantial progress in the United States.

### Monel Metal and Nickel Silver

Monel metal is receiving greater attention in Europe than ever before and has enjoyed a marked increase in consumption, particularly in this country. The valuable properties of the copper-nickel alloys in general are being recognised more and more by engineers as well as by metallurgists.

Experience in 1935 and 1936 has demonstrated that the nickel-silver alloys are holding their position in the non-ferrous field, for outputs of both rolled and cast products have increased. It is noteworthy that, despite the large output during the last decade of spoons and forks and flatware generally, consumption continues to increase appreciably; and nickel-silver remains the material *par excellence* for this application. At the same time, cast nickel-silver alloys have definitely improved their position in the household field, notably in plumbing and sanitary fixtures. The action of the Government in improving and cheapening the telephone service in England has been an important factor in this larger consumption. Manufacturers of telephone equipment are busier than for many years past, and a considerable tonnage of nickel-silver alloys is now being

used in the production of both individual instruments and automatic exchanges.

Reference has been made already to the expanding use of electric heating in the United Kingdom and elsewhere. Tonnages of the nickel-chromium alloys used for electrical resistance purposes are not yet large; but a steady increase in their consumption persists, whatever may be the general condition of trade and industry. Recently, manufacturers of household appliances have improved the efficiency of their products and cheapened their cost, and the number of new electric furnaces installed, not only in metallurgical but also in other industries, will break all records this year.

### Overseas Expansion

Nor is the growing diversification of nickel consumption restricted to Europe and North America. Reports from Australia indicate that the metal is entering industry and construction through a variety of ferrous and non-ferrous alloys, notably in the expansion of the Bunnerong power station which serves the Sydney Metropolitan Area, and in the manufacture of agricultural equipment. In Japan the policy of stimulating home manufacture of automotive equipment and the expansion of textile, chemical and shipbuilding industries have brought about increased consumption of nickel. China is using substantial quantities for pure nickel coinage.

Thus nickel flows in various forms through an increasing diversity of channels into the industrial processes of the world. But the significant feature of this age of alloys, into which the world is steadily moving, is that it leads not only to an intensification of activity in established industrial centres, but also to an extension of this activity to remote areas which hitherto have been commercially inaccessible. Points far into Northern Canada and into the jungles of Africa and British Guiana are now being tapped for their mineral or other natural resources by the use of aeroplanes for the conveyance not only of men and supplies but even of heavy machinery parts which can be assembled into mining and drilling equipment miles beyond the present terminals of effective surface transportation. In this extraordinary development of modern industry, nickel alloys provide the vital parts for the aeroplanes as well as for much of the machinery.

The following summary of the year's developments affecting nickel is based on field investigations made by the International Nickel Company of Canada, Limited, and its subsidiaries.

### Motor Vehicles

Total motor vehicle production in Canada and the United States for the first nine months of 1936 was 3,462,034 units, as compared with 3,012,628 units in 1935, an increase of approximately 13 per cent. Production increased in Great Britain and Germany also, and was slightly reduced in France. At the same time, consumption of nickel per automobile unit more than held its own.

Because American production, which is the outstanding factor in the motor vehicle industry, is geared to the schedule of a new model each year, there is a constant pressure for new materials, designs and features. Nickel-bearing alloys, irons and steels are being introduced as materials for motor vehicle parts not previously containing nickel; in addition, there is a definite trend towards increasing the thickness of the nickel plating which is the basis for the chromium finish used for trim and hardware.

In the United Kingdom the strength-to-weight ratio is of primary importance in automotive design for two reasons, both of which stimulate a more general use of nickel. The continuing tendency to develop more powerful engines without raising petrol consumption excessively has led to increasing demands on individual components, and the nickel steels are favoured as the best materials available for providing high strength in light sections. At the same time, the restrictions which have been placed on the loading per axle of commercial vehicles emphasise the need for reducing deadweight to the minimum. Nickel steels and nickel aluminium alloys are therefore being employed to save weight without sacrifice in the factor of safety.

The builders of French lorries and other commercial vehicles are even larger users of nickel steels for all such stressed parts as gears, crankshafts, etc. In France the average poundage of nickel per passenger car is higher than that obtaining in cars of American manufacture.

Promulgation of the motor vehicle business law in Japan last July prohibits foreign motor-car manufacturers from expanding their plants or businesses beyond the status existing on August 9, 1935. The immediate result has been to attract new Japanese companies into the field and to encourage those already in operation to expand. In effect a domestic automobile industry is being created, which is certain to be of growing importance. As a result the consumption of nickel steels by the Japanese motor industry during the first nine months of 1936 was three times that for the corresponding period of the previous year.

Development of the trailer caravan into an important industry is opening a new field for consumption of nickel alloys. Monel metal and stainless steel are coming into general use for kitchen sinks and wash basins, and a lightweight stainless steel trailer built on the principle of the streamlined Zephyr trains has been placed on the market.

A new section of the transport field has been opened up by the growing use of trackless electric trolley buses in London and other United Kingdom cities as well as in the United States. Nickel steels form such parts as the side members of the frames, front axles, rear axle casings, axle shafts, worm shafts and brake rods. In addition nickel and nickel compounds are the essential constituents of the alkaline storage batteries with which these buses are equipped for manœuvring at terminals and for lighting and actual operation when the overhead supply of current is interrupted.

### Alloyed Cast Iron Used

Another manufacturer of popular low-priced cars has recently been added to the list of those using nickel alloy steel for rear drive pinions. Other manufacturers are increasing the use of nickel steels for differential gears, pinions, transmissions and exhaust valve heads. Austenitic valve heads containing from 8 to 14 per cent. of nickel are rapidly becoming standard in private motor cars. The presence of overdrive units was a development in many of the new American models exhibited in November. These units are made almost entirely of nickel molybdenum steels.

Though the use of alloy cast irons is a recent development, to-day there is hardly a motor vehicle engine casting which is not alloyed, and nearly all contain nickel. This applies to Diesels as well as to the other types of car, lorry and tractor engines.

The American industry has increased its acceptance of nickel cast-iron camshafts and Diesel engine crankshafts, so that a larger proportion of the manufacturers are using them than ever before. Cylinder heads, pistons and brake drums continue to adhere strictly to alloyed cast-iron specifications.

A substantial tonnage of thermostatic alloys containing nickel is now used by the motor vehicle industry. Thermostats control water temperature, carburettor air temperature, automatic chokes, hot water heaters, oil temperature, and even shock absorbers. Some cars carry as many as eight individual thermostats.

Low-expansion nickel-silicon-aluminium alloys, particularly when electrolytically treated for corrosion resistance, are being widely used for pistons in the modern high speed car. They are responsible, in part, for the long life and low oil consumption now being realised.

Cylinder liners alloyed with nickel and chromium or nickel and molybdenum are in regular production for use in heavy duty lorries and buses. Records of 200,000 miles of service before reconditioning is necessary have been established as compared with 75,000 miles for the unalloyed type previously used.

In Germany the designers of motor-car engines using light, quick running oils for fuel have adopted nickel alloy cast iron for cylinder blocks and heads in order to effect important weight reduction in relation to power. The dies used by important American manufacturers for forming one-piece solid steel body tops are made of a nickel-chromium alloy cast iron with alloy steel inserts. A new type of taxicab featuring the "sunshine" roof has a gear ratchet plate of heavy gauge Monel metal as an essential part of the mechanism for opening the roof. Monel metal was chosen because of its strength, resistance to deformation, rustlessness and ease of fabrication.

In the field of heavy-duty motor vehicle equipment streamlined buses of stainless steel have been placed in service across the Syrian Desert, and corrugated stainless steel has been used for insulated bodies for a fleet of lorries delivering products to the chain stores of a large American bakery. The new copper-nickel steels are helping lorry manufacturers to meet the demand for tank lorries, vans and other delivery equipment capable of efficient, low cost operation. These intermediate steels are being used to manufacture lorries and trailers where reduction in weight without sacrifice of strength and wearing qualities is important. A new model of heavy-duty electric fork lorry has been placed on the American market. It develops a lifting torque of 600,000 in.-lbs. and will raise a load of 16,000 lbs. to a height of 86 in. on the forks. More than 67 lbs. of nickel are present in the alloy steels which form the main structure of each lorry.

### Railways

In the railway industry interest is divided among the streamlining of equipment, the redesigning of the locomotives and the trend towards light-weight, intermediate steels for the construction of goods wagons. Not only are more streamlined coaches being ordered by the railways, but there is a tendency towards increasing their size. For example, an American railway system first duplicated its original 3-coach train and quite recently added a 12-coach unit of the same general design, all of which are constructed of stainless steel.

Diesel engines provide the primary power for many of the streamlined trains, and nickel alloy steels, nickel alloys and nickel irons have an established place in the design of these engines; but the principle of streamlining is also spreading to electric locomotives and to the standard steam power units which are being redesigned to furnish higher strength and speed with lighter weight. As a result, the use of nickel is definitely increasing in this field.

As the trend towards reduction in deadweight spreads into the design of bulk freight containers, the use of low alloy, inexpensive steels is passing from the experimental stage into established practice. Nickel and copper (with or without other additions) are essential elements of these intermediate steels and find use for the bottoms and sides of goods wagons. Low cost, cast nickel steels also are being introduced for the side frames, bolsters and other car castings in the trend towards deadweight reduction.

Another factor making for increased consumption of nickel in the railway field is the attention being given to the popularisation of dining cars on the important railway systems of Canada and the United States. Until recently the practice of buying meals on the trains was largely restricted to passengers in the Pullman coaches and other more expensive accommodation. Prices of individual dishes have been reduced, a wider selection of fixed price meals is now offered and in some instances buffet cars have been

added to the dining cars. These improvements are attracting a larger percentage of the travelling public. Inasmuch as Monel metal, nickel silver and stainless steel are standard materials for dining car kitchen equipment and working surfaces, their use in this field is expanding.

### Japan, Belgium and France

In Japan the consumption of nickel in the railway field was up 15 per cent. during the first nine months of the year, and a number of companies are instituting special studies to effect economies through further applications of alloy steels. In addition the Ministry of Railways is giving official attention to nickel alloy steels in locomotives to reduce weight and permit higher speeds.

The Belgian railways have ordered 20 high speed locomotives of the Pacific type in which 2 per cent. nickel steel is specified for the boiler plate and other nickel steel compositions are to be used for such parts as axles, staybolts, etc. In addition, 500 coaches have been ordered, in which stainless steel is specified for handrails, door plates, door handles and other hardware.

Amongst the French systems the Chemins de Fer du Nord is using nickel steels for frames, counterweights and triangular brake parts in their new passenger coaches, the weight of which has been thus reduced from 129 to 75 long tons. The Chemins de Fer de l'Etat has purchased 40 double unit railcars with stainless steel fittings.

### The "Silver Jubilee"

An interesting record made during the year was that of the "Silver Jubilee" train of the London & North Eastern Railway, which attained a speed of 113 miles per hour on one of its regular runs between London and Newcastle. The connecting rods and other reciprocating components of the locomotive used are of a high-tensile nickel-chromium steel. Either this composition or nickel-chromium-molybdenum steel is now standard for reciprocating parts of British steam locomotives, and nickel-steel boiler plate is used in the construction of most new engines.

The British railway systems are also developing the use of Diesel engined trains for services where the traffic volume does not warrant the use of standard steam trains. As the Diesel engines so employed must be light in weight and have a high efficiency, nickel alloy steels are used for crankshafts, connecting rods, transmission gears and driving shafts; while nickel aluminium alloys are specified for crankcases, cylinder blocks, cylinder heads and pistons.

### American Developments

The Paulista Railway of Brazil was among those which turned to nickel cast steels for side frames, yokes, bolsters, centre post braces and other castings to reduce deadweight in the 400 coaches ordered this year. A wagon order from one of the important railways in the United States involved 4,000 yokes, 1,800 bolsters and numerous other castings of the same alloy.

American railways have shown during this last year an active interest in the weight reduction of rolling stock. Among the steels used for this purpose are nickel steel in goods wagon castings and rolled nickel alloy steels for bottoms, sides and doors. Due to the improved earnings of many of these railways, the orders for the wagon castings are coming through in quantities ranging from 250 sets to as many as 2,000 in one instance.

Increase in the production of steam locomotives has resulted in an even larger increase in the use of nickel steels in this field; for, although the Canadian railways are still the leaders in the employment of nickel alloys for engine parts, the American systems are becoming definitely more interested. Nickel-steel boiler plate, tube, sheet and firebox plate, nickel-steel rivets, nickel cast-iron cylinders and bushings, nickel-steel forgings for side and main rods, axles, crank pins and piston rods, and nickel-steel castings for main frames and wheel centres are being specified more frequently by the important railway systems. The railways have continued their progress in the application of nickel alloy cast irons in locomotive and power equipment for cylinders, bushings, wedges, shoes, valve cages, rings and firebox parts.

An important development in the power field is the introduction of centrifugally cast liners of hard S Monel and H Monel metal for boiler-feed pumps on locomotives. These are being used in conjunction with cold-water cylinder liners made of regular Monel metal. Wherever Diesel engine power units are introduced by railways, increased use of nickel alloys results. The standard material for cylinders and liners recognised by one of the leading American locomotive manufacturers is a nickel cast iron. Nickel steels are generally used as bolt material for all types of Diesel engines.

The now famous stainless steel Zephyr trains have already travelled over a million miles each, As they continue in successful operation, other trains of the same type are being built, and they are now in operation throughout the United States. An interesting example of saving in deadweight through the use of a nickel-bearing alloy steel is that of the sun-parlour café lounge coaches built for service on a Western railway in the United States. Two of these coaches have been operating since last April, and railway engineers estimate that they show a weight saving of 30,000 lbs. per coach.

Two five-section subway-elevated coaches of stainless steel are being operated experimentally by one of the underground systems in New York City. Sixty lightweight two-coach articulated units for operation over the new San Francisco-Oakland Bay Bridge have been constructed of alloy steel containing nickel. The success of nickel steel axles in eliminating fatigue failures has led to their use not only for steam and electric locomotives but also for petrol-driven units. Monel-metal and stainless steel equipment for dining cars has increased as the result of the greater attention which the Canadian and American railways are giving to building up their restaurant services. In the case of one railway system, even the kitchen floors and walls are made of Monel metal.

### Marine Engineering

With the growing interest in weight saving through increased strength of materials and especially through improved corrosion resistance, shipbuilders are continuing to turn to nickel and nickel alloys to solve some of their problems. The "Queen Mary" is a veritable exposition of the many ways in which nickel is used in making ocean travel both efficient and pleasant. From the engines to the instruments and from the kitchens to the most luxurious salons, nickel alloys have been employed in creating this new ship. The use of 70/30 copper-nickel tubes in the condensers of the "Queen Mary" is an outstanding example of the recognition being given this material for its resistance to sea water. Its growing use for salt water lines in land installations is also noteworthy.

A two-stroke Diesel engine for marine purposes has been developed in Sweden. Cylinder and cylinder head are cast of chromium-nickel cast iron, and the crankshaft is made of a heat-treated chromium-nickel steel. In addition to the use of Monel metal drive shafting and propeller stub shafts by a number of outboard motor manufacturers, Monel metal is being used in the shape of seamless tubing cast integrally with aluminium motor parts to serve as water circulating passages. This ensures a permanently smooth and uniform section.

The use of lightweight welded Monel metal construction for salt water condenser heads and fresh water surge tanks, which was announced in 1935, has expanded rapidly. In addition, Monel metal is being used in increasing quantities for storage of boiler feed water and for lining the walls of refrigerated food storage rooms on large vessels. Development of a satisfactory technique for welding Monel metal to galvanised steel structural members has been important in facilitating assembly and in achieving appreciable savings of weight.

The first of a series of seven Russian timber carrying ships is equipped with a propeller of a special type, constructed with a cast steel boss and nickel-chromium steel blades.

Stainless steel is being given increasingly numerous applications in the marine field. Stays and halyards of this material are extremely flexible and readily spliced, and their strength and corrosion resistance permit the use of smaller diameters. Stainless steel is also used for deck fittings such as ventilators, cleats, chocks, bitts, and snaps, and for other marine hardware because it eliminates the necessity of polishing.

### Aviation

Whereas aeroplane manufacturers continue to turn to nickel alloys for their high strength-to-weight ratio and shock resistance, such other characteristics of these metals as their corrosion resistance and non-magnetic qualities are also considered important. Thus aviation is typical of the newer industries which have turned to new materials to meet the more exacting demands they place upon equipment.

Inconel, the nickel-chromium alloy which is resistant to both heat and corrosion, is contributing substantially to the safety and efficiency of flying. Most of the major manufacturers of commercial and private planes use it for carburettor preheaters, cabin heaters, exhaust manifolds and other parts subject to the corrosive attack of hot engine gases.

Where strong, corrosion resistant, non-magnetic materials are needed, both Inconel and Monel metal are being employed. K Monel, the heat-treatable type of Monel metal, is growing in popularity for parts of instruments used in navigation, as its non-magnetic feature is valuable in avoiding compass errors. Examples of such uses are artificial horizons and automatic pilot parts.

On September 28 a new world's altitude record was achieved by Squadron-Leader Swain of the Royal Air Force, who reached a height of 49,967 ft. in a Bristol "138" aeroplane fitted with a special Bristol "Pegasus" engine. A performance of this kind places exceptional demand upon the engine parts which must be capable of retaining adequate strength and toughness under abnormal operating conditions. Nickel alloy steels were employed in the construction of the engine for such important components as crankshafts, connecting rods, reduction gears, blower gears, valves and valve operating gear. Nickel-aluminium alloys were used for cylinder heads, pistons and crankcases.

Roller type chain of K Monel has been introduced for lifting retractible landing gear on aeroplanes. This alloy is used because it is non-magnetic and therefore will not affect directional instruments. Among the Monel metal applications in aviation are S Monel for cylinder sleeves, K Monel for propeller blade bushings and Monel metal for tanks to hold insecticides to be sprayed on crops from the air. Nickel-chromium-molybdenum steel castings have been adopted for landing gear by an important manufacturer of aeroplanes. This steel was chosen because of its high elastic properties and its ability to withstand severe shocks.

### Communications

The communications industries continued to rely on nickel for the fabrication of numerous devices, radio maintaining its position as the largest consumer in this field.

An outstanding development of the year has been the introduction of nickel-aluminium iron alloys which have extraordinary high permanent magnetism. These are being used for loudspeaker and ribbon microphone equipment as well as for high-tension magnetos, sensitive galvanometers, and the like, and they are being given particularly widespread acceptance here and in Germany. Development of these alloys has

been due to research and experimental work both in Japan and in the United States.

Regular television service has already been inaugurated by the British Broadcasting Corporation and the necessary receiving apparatus is now being made and sold by several of the larger radio companies. Malleable nickel enters into this equipment in just the same way as it does into ordinary radio apparatus and is employed even more largely in cathode ray tubes, etc. Nickel alloys, particularly nickel irons, are also used.

Nickel and magnetic alloys occupy a strong position in the telephone, telegraph and cable systems of the world. The action of the British Government in improving and cheapening telephone service has stimulated an increased demand for nickel silver. This alloy remains the standard material for contact springs on telephone exchange boards, and considerable quantities of nickel silver have been used for the complicated equipment installed in the many automatic telephone exchanges which have been erected.

### Chemicals

Never before has the attention of the chemical industry been so clearly focused on the problem of materials suitable for its equipment. During the year chemical publications discussed the qualifications of various metals to meet the requirements of the industry, the American Chemical Society devoted a general symposium to new corrosion resisting metals and alloys and published a monograph on the subject, and the Institute of Chemical Engineers featured the same topic at its meeting in London last June.

Monel metal, nickel, nickel-clad steel, stainless steel and similar alloys are called on to meet an increasing number of special requirements in the chemical industry. Significant progress in the use of Inconel was noted, and nickel cast irons for structural parts continued a steady advance. In all cases the combination of strength, durability and corrosion resistance offered by these materials was a controlling factor in their selection. Corrosion resistance is regarded as important both because it makes for more durable and efficient equipment and also because corrosion frequently can cause contamination of products.

Exemplifying the use of nickel by the chemical industry are special containers used to handle chemicals, salt water and other corrosive materials. In these practically the entire range of nickel alloys is used—Monel metal, stainless steel, nickel silvers and Ni-Resist among others. During last year increases in the use of nickel alloys for pump casings, rotors, shafts and other applications were reported. Nickel cast iron is used for retorts, filters, evaporators and similar parts, as well as for structural parts exposed to the splash of corrosive materials.

The coke and gas industries are both enlarging their use of the nickel cast irons. Ni-Hard is extensively applied for crushing, conveying and sizing of coke. Lower alloyed heat and corrosion resisting cast irons are employed for ovens, generators, and condensers and by-product equipment.

A new process for the production of chlorine without the production of caustic soda as a by-product required a large tonnage of nickel for equipment. The production of caustic soda itself accounted for increased consumption of nickel and nickel-clad steel in the alkali industry and in the production of potassium carbonate.

### Rolling Mills

The current programme of modernisation has created a sharp increase in nickel consumption by manufacturers of steel rolls. Heavy demands upon new types of equipment make the nickel alloyed steels and cast irons, including Ni-Hard, especially necessary to resist the speeds and pressures involved. Metal working industries have increased the use of nickel alloyed cast-iron and steel rolls from blooming to finishing mills.

The four-high continuous sheet and strip mills have had a large share of responsibility for the increase. Alloy chilled rolls containing nickel are used increasingly for continuous hot strip and sheet mills, and the tendency is to use nickel alloys not only in the last stands but in all rolls. Rolls for sheet bar and plate made of nickel chilled iron are stronger and give more life between dressings. Many grain rolls for rolling shapes and rounds contain nickel, though only a few years ago they were nickel free. The trend is toward a higher nickel content (2½ to 3½ per cent.) to obtain greater hardness.

There has been a marked growth in our appreciation of the alloy cast irons for rolls employed in hot and cold rolling. Ni-Hard has been found to give excellent results in these applications, not only because of its hardness but also because of its wear resistance. The latter quality gives the roll longer life and greater productivity between dressings.

Other metal-working applications are the use of nickel cast irons for tube mill rolls and accessories, such as piercing points and reeler plugs. The use of Ni-Resist has been extended for pillow blocks and stands and in pickling tanks, where this nickel alloyed cast iron has replaced lead coated cast iron.

Increasing attention is being given in the United Kingdom to the valuable properties which can be obtained in highly alloyed nickel-chromium-molybdenum case-hardening steel. This steel is capable of withstanding exceptionally heavy loading, and has, therefore, been chosen for the manufacture of large roller bearings to be used in sheet rolling mills. Tapered roller bearings having an outside diameter of 51 in. and weighing 3¼ tons each, have been made of this steel.

Many companies have adopted nickel cast iron for large rolls used in making woven wire products. For these a smooth, unblemished surface is required in order to avoid abrasion either of the roll or of the product with which it comes in contact. The rolls must be machined, and difficulties arising from the use of ordinary cast iron have led to the selection of the nickel alloy.

### Machine Tools and Heavy Machinery

The machine-tool industry's increase in nickel consumption during the current year is still another reminder of the effectiveness of the nickel industry's policy of co-operation with other industries in research and experimentation during the dull days of the depression. With the recovery in machine-tool production, more nickel alloys are being used than before.

Elimination of vibration and distortion from the frames of machine tools, and other heavy machinery subjected to increased operating speeds and stresses, has become an important problem to which nickel alloyed cast iron is providing the solution more and more frequently. At the same time, working parts made of these alloys are being used to improve speed and accuracy of operation through the added strength, toughness, stiffness and wear resistance of these materials.

Corrosion resistance is becoming recognised increasingly as a factor in certain types of machine tools, and is being provided by a wider use of Ni-Resist; while the Ni-Hard composition of nickel alloyed cast iron is being adopted for applications involving exceptional wear resistance.

Another reason for the growing popularity of nickel in cast iron is its effect upon the grain refinement of castings. One company reports marked success in making hydraulic cylinder-head castings in weights up to seven tons, since it added nickel to the iron.

Cast iron alloyed with nickel is being used by 67 per cent. of the American machine tool builders because cleaner and closer grained castings can be obtained with this material, according to a survey made by "Product Engineering."

There is a growing interest in this country in Ni-Tensyl iron because of its good mechanical properties and because these can be obtained throughout large sections. Large castings in such applications as the frames and housings of sugar mill machinery are being made of Ni-Tensyl iron for these reasons, while its resistance to repeated shock has led to its selection for printing machine frames.

As a result of research during the past two or three years, nickel-chromium heat-resisting alloys have been developed, which are several times more enduring than their predecessors. An interesting feature of heat-treating practice in this country has been the rapid increase in the number of electric furnaces in service. This has meant larger consumption of nickel-chromium heat-resistance alloys for heating elements, and, in the shape of woven wire, for conveyor belts and similar equipment.

### Agriculture

The marked rise in the farmers' income has been reflected in an increased demand for farm machinery and implements. Combined with the growing popularity of nickel alloy steels and cast irons in the construction of agricultural equipment, this larger volume of unit production has established an important field for nickel consumption.

American tractor manufacturers stepped up their production to a rate which is expected nearly to double that in 1935. The amount of nickel in each tractor varies from 2 to 65 lbs., depending on the model; and types which hitherto used relatively little of the metal have this year more nickel alloys. Progress in the adoption of nickel cast irons for frames and abrasion resisting parts has been notable. A tabulation of the estimated production of tractor manufacturers in the United States shows that the consumption of nickel for tractor production will amount to about 130 tons.

One model of farm tractor has in the neighbourhood of fifty nickel steel and nickel cast-iron parts. Among them are the cast-iron cylinder heads, liners and inserts and the clutch plate; also nickel steel bolts, nuts and studs in both engine and chassis, taper and straight roller bearings, transmission gears and shaft, belt pulley shaft and shaft bevel gears, differential parts, axles, steering worm, steering worm wheel and shaft, clutch parts, crankshaft, fan shaft, intake valves and pump shafts and gears.

A light weight wheelbarrow, which saves about 40 lbs. in weight as compared with more traditional models, has been made from a high-strength nickel-aluminium alloy. Since wheelbarrow transportation is rated as one of the most expensive, as well as one of the most common types of material handling, the weight saving and practicability of increased loads make the new vehicle significant from an economic point of view.

### Pulp and Paper Industry

The year has seen an increase in the use of corrosion-resisting materials, including a number of nickel alloys, by the pulp and paper industry. Monel metal and other nickel-containing alloys have enjoyed increased usage for such applications as black liquor evaporator tubes, slotted screen plates, jordan bars, tank linings, stock pipe and saveall trays in the pulp and paper industry.

Data compiled from records of Ni-Resist in service indicate that it is the ideal material for blow pipe lines in sulphite digesters. Ni-Resist installations have lasted several times as long as cast iron without showing signs of failure. Nickel cast irons are being used in larger quantities for such parts as valve pumps, digester fittings, pipe, beaters and other paper machinery parts subject to stress and corrosion.

A new application is the use of high-grade nickel alloy cast irons for large roll shells, some of them thirty feet in diameter, used in the manufacture of crêpe paper for towelling and similar stock. In these the finer finish, closer grain and improved resistance to wear of the nickel cast iron have permitted speeding up production.

# Recent Developments in Foundry Research

By J. G. PEARCE, M.Sc., M.I.E.E., F.Inst.P. (Director, British Cast Iron Research Association)

DURING 1936 two Papers have been published by Dr. A. L. Norbury and Mr. E. Morgan which form a most important contribution to the present knowledge of the mode of formation of graphite in cast iron. They deal with what became known about two years ago to members of the B.C.I.R.A. as the titanium-carbon dioxide process, which is covered by British Patent No. 425,227 and certain foreign patents, although the procedure followed has a high theoretical value in leading to a better understanding of graphite formation, quite apart from its merits as a possible commercial process. The first announcement published of the matter was given to the Glasgow Conference of the Institute of British Foundrymen in a Paper on "The Fracture of Pig-Iron and Cast Iron."[1] The subject was also dealt with more comprehensively from the metallurgical point of view in a Paper[2] given to the Iron and Steel Institute, and published in September, on "The Effect of Non-Metallic Inclusions on the Graphite Size of Grey Cast Iron." The present writer drew largely on the developments disclosed in these two Papers in the Institute of British Foundrymen's Exchange Paper to the Düsseldorf International Congress.[3]

MR. J. G. PEARCE, M.SC., M.I.E.E., F.INST.P.

The authors explain the circumstances which led to doubt being cast on what had became known as the graphite nucleus theory, in which it was supposed that, in ordinary cupola melting, the graphite present in the charge had neither time nor temperature to cause complete solution. The undissolved particles of graphite in the molten metal, getting into the ladle and into the mould, were supposed to act as originating centres or nuclei for the formation of flake graphite. Various developments had appeared to confirm the correctness of this theory, notably the refinement of graphite by superheating the melt, by the incorporation of steel in cupola charges, by jolting the metal in the ladle, and so on, and the commercially valuable inoculation processes appeared to depend on it. The Paper by Judson[4] given at the Glasgow Conference is worth careful study in its bearings on this point.

Direct experiments, however, showed that graphite actually dissolved quickly and the possible causes of variations in graphite size were consequently looked for in the presence of gases and/or non-metallic inclusions in the melt. After a considerable number of experiments it was found that a remarkable change, quite unlike anything experienced in any other treatment, followed on the addition of ferro-carbon-titanium to the melt, originally tried as a deoxidiser, followed by the addition of calcium carbonate. Still more positive results were obtained by utilising more readily melted ferro-alloys, containing titanium, and by the use of carbon dioxide gas, and in a short time it became possible to melt an ordinary pig-iron, which in a 3-in. bar had a very coarse fracture, and convert the graphite into an extremely finely divided form, in the same section, by adding to the melt 0.2 per cent. titanium and subsequently treating it with carbon dioxide for two minutes. The finely divided graphite is referred to as "supercooled" graphite. The first mentioned Paper quotes a case of an iron containing 3.6 per cent. carbon, in which the transverse strength was raised by this treatment from 17.4 to 30.3 tons per sq. in. in a 3-in. section. No change in composition took place, apart from that involved in the addition of the small quantity of titanium which, it is now believed, does not affect composition in the ordinary sense. It was also found that the original coarse fracture could be restored by treating the refined melt with hydrogen and a complete cycle of graphite refinement and coarsening became possible. The explanation of the results put forward by the authors is ingenious, but in the nature of the case is difficult of direct proof.

The new theory does not abandon the idea of the effect of a nucleus on crystal formation, but changes the nucleus from the undissolved graphite particle to the non-metallic inclusion. It is well known that cast iron contains such inclusions in the form of sulphides, oxides, silica and alumina, the last two existing for the most part as silicates or slags. The new theory, briefly, supposes that these particles, which would normally have a melting point higher than that of the metal, are solid and crystalline before the melt solidifies and are consequently capable of inoculating the melt to serve as

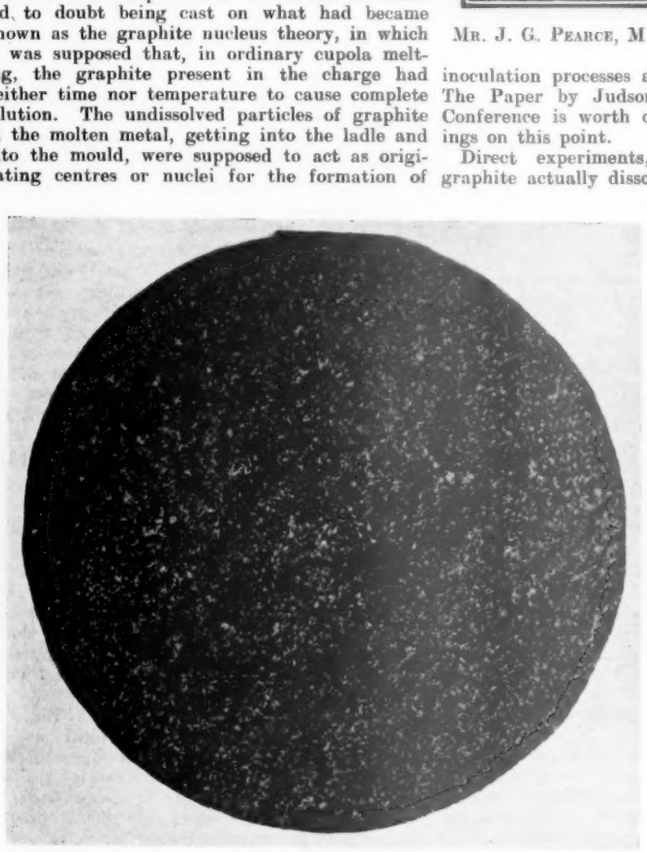

FIG. 1.—THREE-INCH SAND CAST BAR, UNTREATED, EXHIBITING COARSE GRAPHITE.

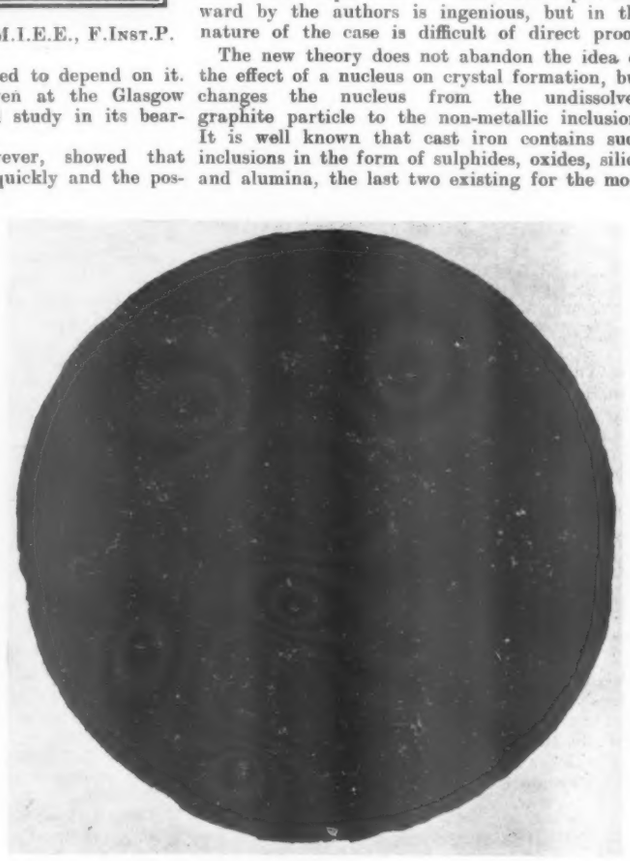

FIG. 2.—THREE-INCH SAND CAST BAR, TREATED, EXHIBITING FINE GRAPHITE.

nuclei for the precipitation of graphite. This theory actually explains quite satisfactorily the effects of graphite refinement observed after superheating and other treatments mentioned above. It is known that titanium in the presence of $SiO_2$ and MnO can be oxidised to a very low melting point slag, and it is supposed that the effect of the oxidising gas is to coat the existing

FIG. 3.—UNTREATED METAL SHOWING COARSE GRAPHITE. UNETCHED. × 200.

solid non-metallic particles with a slag envelope which is fluid at the temperature of solidification of the metal and which therefore does not inoculate the melt in the same way as a crystalline particle. Various other results confirm this general idea. It has been suspected for some time that silicon in cast iron is present at least in part in the form of silica or silicate, and in this case silicon would be a fruitful source of

FIG. 4.—TREATED METAL SHOWING FINE GRAPHITE. UNETCHED. × 200.

the non-metallic slag particles. Any reduction of silicon therefore should tend to yield a finer graphite size, and, although complete elimination of silicon is very difficult on account of its universal presence in all raw materials available for work of this kind, the graphitisation of a very low silicon material with nickel, which does not form slags or oxides, yields a very finely divided graphite of the same type as that referred to above.

### Effect of Copper on Cast Iron

In the course of another research on the effect of copper, it was found that copper is capable of dissolving in cast iron up to about 3.5 per cent., thereby producing a definite refinement of the graphite flake. Over about 5.5 per cent. it was found that free copper appeared in the structure, being thrown out of solution and visible to the naked eye. In between these two limits, copper above 3.5 per cent. and below 5.5 per cent. appears in the structure in a very finely divided form, visible only microscopically. It was thought that if the above theory were correct, copper present in excess of 5.5 per cent. and thrown out of solution should have a somewhat similar effect to the oxidised titanium in coating the slag particles, thereby producing the finely divided graphite. This was tried and actually proved to be the case. These effects due to nickel and copper give material support to the general theory.


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2 Norbury and Morgan. "Effect of Non-Metallic Inclusions on the Graphite Size of Grey Cast Iron." Iron and Steel Institute, September, 1936.

3 Pearce. "Graphite Structure of Grey Cast Iron and its Modification." Exchange Paper of Institute of British Foundrymen to the International Foundry Congress, Düsseldorf, 1936.

4 Judson. "Founding of Pressure Castings." Institute of British Foundrymen, Glasgow Conference, June, 1936.

5 Colbeck, Craven, Murray. "Determination of Non-Metallic Inclusions in Steel and Iron." Iron and Steel Institute, September, 1936.

6 Tapsell, Becker and Conway. "Behaviour of Five Cast Irons in Relation to Creep and Growth at Elevated Temperatures." Iron and Steel Institute, May, 1936.

7 Gough and Pollard. Institution of Mechanical Engineers, November, 1935.

8 "Typical Microstructures—Series II." Institute of British Foundrymen in collaboration with the B.C.I.R.A. 1936.

9 Harbach. "Toughness of Cast Irons from Transverse Stress-Strain Curves." FOUNDRY TRADE JOURNAL, August 20, 1936.

10 See FOUNDRY TRADE JOURNAL, January 2, 1936; July 2, 1936; October 8, 1936; November 5, 1936.


The investigation shows the fundamental nature of the metallurgical principles involved, for it is suggested that the theory advanced explains the process used in the modification of the aluminium-silicon alloys, and the extraordinary similarity of the change structurally in the case of the aluminium-silicon alloys and cast irons changed from the coarse to the fine state has resulted in the finely divided irons being called "modified cast irons." Thus cast iron can now be cast both in the normal and in the modified state. It is particularly interesting to note that, provided the iron is not kishy, the change is independent of the carbon content, and hence there are possibilities of getting fine graphite in easily-melted, readily-cast irons relatively free from shrinkage.

### Extended Trials

This process has hitherto been confined in the main to crucible melts, but is now being applied to other furnaces, including the cupola, and it is likely that efforts to produce fine structures from the cupola will throw a good deal of light on the phenomena of cupola melting. The commercial application of the process either to the blast furnace or to the foundry cupola must naturally await the complete solution of this problem, and will be of particular interest from the point of view of mechanical properties of the resulting irons, and also from the point of view of finishing processes, such as tinning, enamelling, galvanising and plating, where graphite cavities are apt to create difficulties. The discussion on the Paper to the Iron and Steel Institute by leading metallurgists shows the extent to which the Paper is recognised as important, and Mr. J. E. Hurst's prediction of the revolutionary changes it will make in current ideas and practice seems amply justified.

Figs. 1 and 2 show fractures of 3-in. sand-cast bars before and after treatment. The fine graphite in the treated bar makes it look black. Figs. 3 and 4 show the structures of the two

FIG. 5.—GRAPHITE IN CAST IRON CONTAINING ABOUT 3.5 PER CENT. COPPER. UNETCHED. × 200.

bars at 200 magnifications. Figs. 5 and 6 show the change brought about by copper additions below and above the limits referred to.

### Non-Metallic Inclusions

In a Paper given to the Iron and Steel Institute in September, Mr. E. W. Colbeck and his colleagues[5] dealt with the determination of

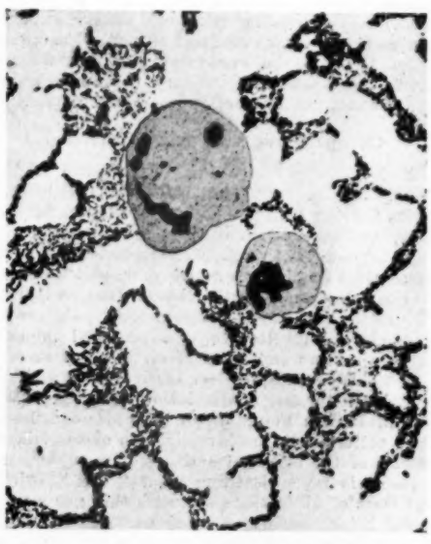

FIG. 6.—GRAPHITE IN CAST IRON CONTAINING 5.5 PER CENT. COPPER. TWO GLOBULES OF FREE COPPER ARE SHOWN. UNETCHED. × 200.

non-metallic inclusions in steel and iron. The Heterogeneity Committee have done much work in this direction on the steels, but the amounts present in the pig and cast irons are very much greater and the problem is accordingly more difficult. Even in a hematite iron free from phosphide, the inclusions reach a remarkable

figure. The B.C.I.R.A. is separating inclusions both by the iodine method recommended by the Heterogeneity Committee and the chlorine method examined by Mr. Colbeck.

### Heat-Resisting Irons

Among the work done during the year on heat-resisting irons, attention may be directed to the Paper[6] on five cast irons by a group of members of the staff of the National Physical Laboratory on irons supplied by the B.C.I.R.A. This Paper contains the first really comprehensive results of creep tests on cast irons, and the irons include engineering grey iron, plain and alloyed, Silal and the austenitic irons, Ni-Resist and Nicrosilal.

Work on cast crankshafts has been actively pursued, both with regard to research and development, and the number of cars so equipped increases rapidly. An account has been given[7] of an ingenious machine devised at the N.P.L. for submitting specimens to specific combined stresses in torsion and bending, of the kind which the crankshaft has to withstand, and the N.P.L. has now carried out tests on several materials supplied through the B.C.I.R.A., including cast steel and cast irons. It is anticipated that the results obtained will be published in the near future, and Dr. H. J. Gough, of the N.P.L., has already hinted at a considerable extension of this work by the B.C.I.R.A. and the N.P.L., under the auspices of the Institution of Mechanical Engineers.

Among Papers on testing, the Institute of British Foundrymen[8] has published its second booklet on typical microstructures, issued in collaboration with the B.C.I.R.A., and while such structures cannot in any way be regarded as standards, they illustrate the differences to be expected between one type of iron and another. Mention may also be made of Mr. Harbach's French Exchange Paper,[9] giving an extremely useful series of results on deflection and set in transverse and broadly confirming the results published by the present writer in 1934.

The enormous growth of the enamelling process and the activities of The Institute of Vitreous Enamellers have resulted in a group of Papers on this important subject, among which may be mentioned those of Wilson, Angus, Hallsworth and Coupe.[10]

# Recent Developments in the Refractories Industry

## By W. J. REES, M.Sc. (President, Refractories Association of Great Britain)

A DICTIONARY usually defines a "refractory material" as one which is "difficult to fuse," but the modern refractory has to withstand many other conditions than that of high temperature alone. Higher working temperatures, highly active slags, and greater rates of melting have increased enormously the severity of the conditions to which furnace linings are exposed, and it is only possible to meet these conditions by a thorough understanding of the conditions of service and a fundamental knowledge of the characteristics of particular bricks.

The past year has provided definite evidence of progress in the production of refractories which will give good service under severe operating conditions and which will enable the metallurgist still further to increase the rate of production from his furnaces. A progressive policy in rebuilding and re-equipping works, which was a feature even in the lean years, is now bearing fruit, and British refractories will bear comparison with those produced elsewhere in the world.

The refractories industry has become alive to the need for continuous activity in research in order to meet the ever-increasing demand for bricks and other refractory products which really merit the name of "super refractories."

### Co-operative Research Activities

A development of special importance is the setting up in the great steelworks of laboratories for the testing and study of refractories; thus, another link in the chain of progress has been forged. The British Refractories Research Association has had an active year, and its effective co-operation with the British Iron and Steel Federation and the Institution of Gas Engineers is producing results of great practical importance to makers and users of all types of refractories. The Iron and Steel Institute, the British Cast Iron Research Association and the Institute of British Foundrymen have also continued their activities in the investigation of specialised aspects of the selection and use of refractories.

There is no such thing as a "best" brick, and least of all is there any such thing as a universal brick, because a brick can only be good or bad in relation to the purpose for which it is intended. It is because of this that it is essential that the study of operating conditions in furnaces should go on side by side with the study of the refractory furnace linings.

It is possible that the era of an important change in the type of brick used in the roof of the basic open-hearth furnace has arrived. The comparatively small difference between the melting temperature of the purest and most efficient silica brick and the desired operating temperature of the modern basic steel-melting

MR. W. J. REES, M.Sc.

furnace is a limitation in the steel-melting furnace which may have to be removed by the substitution, for the silica bricks at present used in the furnace roof, of even more refractory bricks of basic character similar to those bricks employed in the hearth and walls. This possibility has been foreseen by makers of steel-furnace refractories in this and other countries. Much intensive experimental work has been, and is still, in progress, in which fundamental research work on the characteristics of magnesite, and mixtures of magnesite with other materials such as chromite, is applied.

### A Composite Brick

As a result of this welding of fundamentals with practice, composite chrome-magnesite bricks are now being produced and put into service. It is satisfactory to record that the recent British products of this new, and yet experimental, type bear comparison with those of foreign production, but as they are of necessity much more costly than silica bricks it remains to be seen whether, despite their superior refractoriness and resistance to corrosion, it will pay to use them. A high first cost is no longer the bogey it used to be, now that adequate data in regard to the cost in refractories per unit of product are available at most plants.

### Better Equipment Installed

In the production of these specialised super-refractories it has been found essential to utilise the latest and most efficient types of crushing, screening and grading machinery, and to exercise the most exact control at each stage of the process. The perfection of shape obtained through the forming into shape of the bricks in powerful presses is an important factor in their service durability, as they can be built together with the thinnest possible joints, so eliminating what has been a source of weakness.

### Insulating Materials

The increasing cost of fuel has had a remarkably stimulating effect on the use of bricks of low thermal conductivity and low heat capacity which reduce to a great extent the loss of heat by radiation from the walls and roof of the furnace, and, in many cases, by conduction into the ground on which the furnace is built. The thermal conductivity of these bricks is less than one-sixth that of ordinary firebricks, and their use in furnace construction not only reduces the fuel consumption, but with intermittent furnaces reduces the time necessary to heat the furnace to the working temperature.

The past year has seen a marked increase in the production of a special type of brick which is best described as an insulating firebrick, because it is of high refractory value and does not shrink on continued maintenance at a fairly high temperature.

### Ancillary Refractories

Developments have been continuous during the past year in those works which specialise in such important accessories to the making of sound steel castings as runner bricks, ladle bricks, sleeves, stoppers, nozzles, etc. A number of the plants have been almost completely mechanised so as to ensure uniformity in the grinding, grading and tempering of the carefully selected clays. The use of specially designed continuous tunnel kilns, in place of the old types of intermittent kiln, is enabling the most exact control of the burning of these products to be exercised. Incidentally, through the application of these new methods, the time of transformation from raw clay into a finished product now takes as little as three or four days, instead of the former two or three weeks.

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IN ORDER to be able to deal more readily with the growing volume of work on hand at the works of Hadfields, Limited, Sheffield, the company has entered into a new agreement with the Sheffield Corporation for a bulk supply of electricity to be delivered from one central point at 33,000 volts. Hitherto, the current has been supplied from several points around the works at 11,000 volts.

# District Foundry Activities Analysed by Experts

## EXCELLENT PROGRESS REGISTERED

## THE LONDON AREA

BY R. B. TEMPLETON (Managing Director, Ealing Park Foundry, Limited)

THE area covered by this survey may be taken to include all foundries situated in the Metropolis, and the Home Counties, including Bedfordshire, and it is estimated that in this area there are at least 600 foundries operating at the present time. Included in this number are some of the largest foundries in Great Britain, as well as small non-ferrous shops such as one finds in various backyards in the Midlands. It would appear that the foundries producing what are known as castings for the building trade and domestic requirements are responsible for the greater part of the total production in the area. In this category are rain-water castings, baths, gas and electric cookers, etc.

In the gas stove industry two foundries are working at 100 per cent. capacity, and one has recently mechanised a section of its foundry. It is estimated that 25 per cent. of the total production of gas cookers is now made in the London district. The production of electric cookers is also centred largely in the South of England, and all the foundries concerned in the manufacture of these cookers are working to full capacity. An interesting point in this connection is the development of a heat-resisting iron able to withstand the higher temperatures now required by this industry. In the rain-water goods and bath foundries great progress has been made during the year, and one foundry has recently undertaken a very extensive scheme of mechanisation.

Jobbing foundries which cater for the general engineering casting business are also full up with orders, but here the position is not so happy, owing to the dearth of skilled moulders. Deliveries are naturally affected, and it seems probable that, as long as the present volume of orders is maintained, the position cannot be improved, as practically every available moulder is now in employment. A foundryman summed up his position by saying, "Now that I have plenty of orders and cannot get more moulders, I do not sleep any more soundly than I did a few years ago when I had no orders and a few moulders." In general, it may be stated that jobbing foundries are working to 100 per cent. capacity, and in some cases extensions to premises are being undertaken. It would seem, however, essential that a migration of skilled labour from other areas is of primary importance to the foundry industry in the London district. One large old-established London foundry, Henry Edie & Company, Limited, have recently moved their foundry to new and essentially modern premises without losing a day's work.

Foundries which cater for high-duty castings and special irons report excellent progress, and are able to obtain prices which enable them to make a reasonable profit, and in several cases the overseas markets are now being entered upon. Casting prices generally, however, do not appear to have reached a point where this reasonable margin can be obtained by the general run of foundries. Deliveries of raw material may be considered satisfactory, with the exception of scrap iron and steel, which now command prices almost double those of two years ago.

The London area is still a very large market for the repetition foundries situated in the Midlands, and with the substantial development of industry in the South during the past ten years, is likely to remain so, as they are able to quote prices which do not appear remunerative to repetition foundries in the South. Foundries specialising in the production of pianoforte frames, a typical South of England trade, report improving trade conditions.

The number of steel and malleable-iron foundries is small in this district, but two important steel foundries are working to 100 per cent. capacity, and both are extending their plant and production. One of these now ranks with the large steel plants of this country, and its equipment is being extended and modernised, while the other is mechanising a section of its activities.

The malleable-iron foundries report good trading conditions, and it is interesting to note that the Ford Motor Company have recently installed a malleable-iron foundry working on a continuous system with very satisfactory results. This company is spending very considerable capital sums on extensions to, and re-equipment of, its foundry.

Turning to the non-ferrous foundries, it is pleasing to report that the propellers of the "Queen Mary," and of most of the large ocean liners and warships, have been made in this district, and it might almost be said that the manufacture of manganese-bronze propellers is centred in London. Non-ferrous foundries report better trading conditions, although competition from the Midlands is severe. Prices have improved and most non-ferrous foundries have recovered some of their pre-depression prosperity.

The London Branch of the Institute of British Foundrymen has continued to prosper under the chairmanship of Mr. V. Delport, and during the year a section was formed to serve the foundry industry situated in East Anglia. This section will fill a long-felt want, and the capable committee which has been elected should ensure its future success.

During the year a joint meeting with the Birmingham Branch was arranged, and included a visit to Woolwich Arsenal. The London Branch has so far enjoyed a most interesting technical session, and a visit to Belgium is scheduled for this spring. One cannot close this report without complimenting Mr. H. W. Lockwood on the very efficient manner in which he carries on his duties as Branch honorary secretary.

## BIRMINGHAM AND DISTRICT

BY OUR OWN BIRMINGHAM REPRESENTATIVE

Last year was the best experienced by foundries in Birmingham and the neighbouring district since 1929, and in some respects it excelled the high-water mark previously attained. For several years past there has been great building activity in this part of the country as in others within its radius of supply, and there were fears that the impetus thus given to the light castings trade might wane. The contrary proved to be the case. Public housing schemes were not prosecuted with quite the same vigour as previously, apart from the exigencies of re-housing due to slum clearance; private enterprise, however, shouldered a great part of the task of providing more houses where there was obvious need, whilst cheap and abundant money awaiting investment on good security simplified the financial processes.

### Heavy Engineering

While the light foundries were kept well engaged steady improvement in heavy engineering industry brought into full service foundries which previously had been only partially employed. Wider diffusion of purchasing power was reflected in a more regular turnover in the jobbing foundries. In the second half-year the pressure of work gradually increased until it was exceptional to find any unutilised productive capacity in the industry. In some directions demand was even greater than supply.

Now at the beginning of another year there is promise of continued good trade. The momentum is not only maintained, it gives indications of gaining further strength, and in this faith more extensions of output are being planned. Not only has the industry been re-inspired with a spirit of enterprise which years of depression had in some instances dulled, but the more regular working of the foundries has provided the means to expand them and effect technical improvements out of internal resources. In this way a renascence in foundry practice has been stimulated.

### Rising Costs

With fuel, metal and labour costs rising, foundries have had to obtain indemnification in higher selling prices. More working capital has been required as heavier and more costly stocks of raw material have had to be carried to provide against contingencies. Before the year's trading was entered upon the position of the ferrous foundries in regard to pig-iron supplies had been reversed. It was no longer possible to rely on hand-to-mouth buying, getting prompt deliveries from makers' stocks as in the former days, when more pig-iron was being produced than could be consumed. Foundrymen were well provided with stocks of raw material when the year opened, and had arranged contracts which safeguarded them against dearth and market appreciation.

### Raw Material Position

This proved to be their sheet anchor. When the year began some of the smelters had stocks of pig-iron accumulated in the lean years and which they were anxious to liquidate. There was, moreover, a substantial amount of unemployed blast-furnace capacity in reserve. When the summer had passed, development in the civil trade had been superimposed by an emergency demand for the reinforcement and equipment of the sea, land and air services, and foundrymen could not but have misgivings as to the sufficiency of the pig-iron supply. Market conditions became stringent. Stocks at furnaces were absorbed, a few Derbyshire plants alone excepted, and difficulty arose in getting furnace coke. Mild weather in the early part of the winter helped to solve this problem. Virtually all the available resources of the blast-furnacemen were mobilised.

### Repercussions from Spain

Foundries often had only a slender margin of raw materials in hand. They were kept going, but it was only done by making large adaptations in the mixtures of pig-iron on which many of them had based their practice. Often Derbyshire pig had to be substituted for Northants makes, with consequent increase in cost. The range of hematite coming on the market was

restricted by the difficulty of maintaining imports of ore from Spain. Special prices had to be paid during the greater part of the year. The rate for East Coast No. 1 hematite and West Coast mixed numbers rose between January and December from 88s. to 109s. 6d., the latter being subject to a rebate of 5s., which was instituted during the year, as a safeguard against importation. Midland No. 3 foundry advanced 11s. to 83s. 6d. for Northants and 86s. for Derbyshire. Some of the foundrymen state that while their selling prices have been forced up by dearer raw material and higher operating costs, the advance has not been commensurate with the increased turnover.

### Plant Extensions

The new year has been entered upon in favourable conditions. Productive capacity is now larger than it was twelve months ago. Many firms have changed over in the meantime from the old system of founding, to continuous production on a mechanised basis. Over 100 Balanced-Blast cupolas are now in operation in English foundries. Installations abroad bring the aggregate up to about 150. This points the way to much desired economies in coke. The shortage of labour is a serious obstacle to expansion. It will inevitably throw upon technical improvement increased responsibility for meeting the demand for larger outputs. Not only is there a deficiency of competent workers of the artisan class to man the foundries, but the difficulty of finding enough foremen, charge hands and skilled hands for staff jobs has been increasingly evident. This is an aspect of the rapid evolution in the industry which has been long foreseen. Measures have been instituted in various directions for strengthening personnel, the most conspicuous being the British Foundry School established at Birmingham. Working experience in this enterprise has convinced its promoters they are on the right lines for giving the industry the infusion of new blood in key positions of which it stands in need.

## THE EAST MIDLANDS

BY S. H. RUSSELL (Past-President, Institute of British Foundrymen)

When thinking of industry in the East Midlands the average person, unless he happened to know the North-Eastern section of this somewhat nebulus region, would think of boots, hosiery, lace, rayon and other basic industries, such as agriculture and dairy farms, but it is doubtful whether he would ever turn his thoughts to cast iron.

It is to be hoped that such a person is aware that outstanding examples of motor cars, trolley buses, cranes, boilers, machine tools, machinery for the shoe industry, the hosiery industry, wood-working machinery, aeroplane engines and typewriters, are all made in countless quantities, and that nearly all of the leading firms engaged in these industries are to be found in this delectable area.

Unless the Erewash Valley, and that rather grim area of country around the old Derbyshire blast furnaces are known to him, he is not brought into contact with cast iron. Probably this is due to the rather retiring nature of all ironfounders, to their modesty, and the fact that with one notable exception they seldom have anything to sell direct to the public.

Nevertheless, they are there and in considerable strength. One malleable ironfoundry alone is producing well over 400 tons of castings per week. Another foundry is the leading exponent of mass production, and every year enlarges its premises, whilst paying its shareholders a very handsome return on their investment. One huge establishment is making nothing but mechanical stokers and other appliances for the efficient handling and combustion of fuel. Cast-iron pipes were first centrifugally cast in this district, and this same firm has a very modern plant for the mass production of all types of pipes, tunnel sections and cast-iron road blocks set right in the centre of the " Shires " and known by sight to the foxhunters of more than one famous pack of hounds. Many other foundries, some large, some small, are to be found in every town, and their products find their way to places far distant from these peaceful shires.

Acute observers will know that most of these foundries are keenly alive to the great advances which have been made in the industry, many have already modernised their plant and methods, and with the return of prosperity others are fast following suit.

The East Midlands foundrymen are looking forward with considerable pleasure to entertaining the members of the Institute of British Foundrymen during the coming summer. Although two previous annual conferences have been held in the area, strangely enough this will be the first one to be held at Derby, although this town is by far the most important foundry centre of the district. Visitors may look forward to many interesting and novel features during the conference. The civic authorities are taking an intense interest in all the arrangements, so much so that difficulties having arisen as to adequate accommodation being found for certain of the functions, a large new secondary-school building has been put at the Institute's disposal.

Members will also be interested to hear that the first citizen of Derby is a Lady Mayoress, and that she is taking a considerable personal interest in the local arrangements. Some of the most interesting foundries in Great Britain are to be found in Derby; the country adjacent is famous for its beauty, and the hotels, if not large, are numerous, so that altogether ironfounders in the East Midlands are hoping that the current year's conference will be an even greater success than the other two previously held in the neighbouring city of Leicester.

## THE SHEFFIELD AREA

BY J. ROXBURGH (President, Sheffield Branch, Institute of British Foundrymen)

It is very gratifying to be able to report that, as far as Sheffield is concerned, there has been a gradually increasing activity in the iron and steel trades since the beginning of the year, and at the present moment it can be definitely stated that boom conditions are existing. All sections of the industry appear to be in receipt of good orders, whilst the prospects for the present year are extremely good. The requirements of the home market, together with Government work, are responsible for a large part of the present boom. At the same time, local industrialists are paying considerable attention to the question of the possible, and very necessary, increase in the volume of export business, which, in normal times, is of paramount importance. It is interesting to record, in this connection, that the English Steel Corporation, Limited, of Sheffield, have recently secured an order to the value of £100,000 from Italy, and, following the agreement between the British and Italian Governments, it is hoped that trade relations between these two countries will be resumed on as successful a basis as existed prior to the unfortunate cessation of trading. Other companies in Sheffield have carried out orders for Russia, and have delivered to that country huge plants executed with the highest degree of engineering skill. Although the export business is considerably lower than some years ago, it is gradually increasing; but there is still a long road to traverse before the eminent position this country once held in world markets is regained.

In Sheffield and the surrounding district many firms have found it necessary, by reason of the increased volume of trade, to repair their plant, to alter or extend their means of production and, probably with few exceptions, to install more modern machine tools and all types of furnaces, to make them more efficient and up to date, to increase their output and to enable them to become more competitive. Prices for the finished articles produced are certainly higher, yet they seem to be generally lagging behind the prices for raw materials, scrap and machine tools, and at the same time there seems to be a scarcity of raw materials such as hematite. Deliveries for machine tools and similar plant are very protracted. The building trade and steel-construction firms are very busy, and the demands on tool makers and steel manufacturers have increased considerably.

### The Steel Trade

It can be safely stated that last year was, in many respects, a record-breaking one, and particular mention must be made of the production of steel in Sheffield. The rolling mills have created individual records, and the chairmen of various firms have provided very interesting statistics in their speeches. The Master Cutler, in a speech delivered on the occasion of his installation, predicted a further expansion of Sheffield steel production in the near future. He said it was expected that in 1936 there would be a record total of one and a-half million tons. In 1913, 900,000 tons were produced, which was a record up to that date. A new record was created in 1929 which showed an increase of 33 per cent., but this was exceeded in 1935.

At the time of writing there is every indication that the 1936 production may be 25 per cent. higher still, and should reach, in the Sheffield district, a total of no less than 1,500,000 tons.

The production of special steels in the Sheffield district has increased 80 per cent. since 1913, and there is every prospect of a slow but definite expansion in the immediate future.

These figures mean greater employment, for whereas at the end of August, 1935, there were nearly 32,500 unemployed in Sheffield, the figure on October 7, 1936, was about 24,500, which meant that some 8,000 more men had found work in the city within 13 months.

### Local Achievements

There are some definitely outstanding achievements of the local engineers and ironfounders to which reference should be made. A plant for the low temperature carbonisation of coal was opened in October at the Bolsover Colliery by Col. Bristowe, who referred, in his speech, to the various parts of the plant which had been supplied by local firms, particularly mentioning the alloy cast-iron retorts, manufactured in the foundry of Davy Bros., Limited, who were responsible for the manufacture of the first retorts to be made, and those for all subsequent plants erected by Col. Bristowe. In connection with the great modern rolling mill plant which is to be erected by Richard Thomas, Davy Bros. are supplying certain parts in collaboration with the United Engineering Company of America, and they are extending their machine shops and installing two 80-ton cranes to handle the large castings which will be required for this contract, and for the large presses for which they are famous.

Last year witnessed the manufacture of the largest ingot mould ever made in England; this mould weighed 150 tons and was manufactured by the Brightside Foundry & Engineering Company. This firm have also carried out large

alterations in their plant and are extending their foundry at their Ecclesfield Works.

Newton Chambers & Company have been entrusted by the Sheffield Gas Company with the manufacture of the largest gasholder ever produced. The same concern is also making all the iron and steel work in connection with this new gas plant. Other local firms, such as Markhams, Sheepbridge Coal & Iron Company, and Sheepbridge Stokes Centrifugal Castings Company, are extremely busy, and participating to the full in the revival of trade.

### Technical Activities

The widespread dealing in industrial shares, and the high level of prices attained for them, are indeed significant, and there seems to be no reason why the activity in trade, now evident, should not be continued for a further period of two or three years. The improved trade conditions have had their effect on the institutes and societies associated with the iron and steel trades.

The Sheffield Branch of the Institute of British Foundrymen has recorded increased membership, as well as a general increase of interest in its activities. It was felt, last year, that an endeavour should be made to recruit some of the members of the Sheffield Trades Technical Society, and with this end in view, a Joint Meeting was arranged. This took place on January 7, when Dr. Longmuir, a life member of both societies, and well known for his achievements, presented a Paper. The Branch is hoping that this effort will bear fruit in a further increase in membership.

A further innovation—introduced at the November meeting—was a Short Paper Competition, suggested by the President, and this proved highly successful, and the winners of the first and second prizes were, it is encouraging to report, entirely new authors. A joint visit to the works of International Combustion, Limited, Derby, and a joint meeting were held with the East Midlands Branch in November. About 130 members attended, which contributed to a very successful outing.

In July Mr. J. E. Hurst completed his year as President of the Institute, and he is to be congratulated, particularly by the Sheffield Branch, of which he is a member, for the capable and distinguished manner in which he carried out the duties associated with the office.

Another item of local interest is that the total membership of the Sheffield Trades Technical Society is now about 1,250, of which over half attend some of the courses of lectures and laboratory instruction. These courses prove extremely helpful to the members, and other applications have been received for additional classes from furnacemen in the rolling mills and forges, and from members of the clay working trades. The classes for foundry practice continue to be well attended, and arrangements are under consideration to provide further instruction beyond the scope of the present classes in the shape of lectures by specialists on chosen subjects.

Trade is flourishing in Sheffield, greater interest is being displayed in the societies and classes associated with the iron and steel trades, and local foundrymen can look to the future with great confidence, knowing that efforts are being consistently made to improve and develop both the practice and technique of the trades, which have made Sheffield of world-wide renown.

## THE NORTH-EAST COAST

BY A CONTRIBUTOR

The industry of the North-East Coast, with particular reference to foundry activities, is a subject which holds few of the improvements such as have been experienced by the trade in other parts of the country. Indeed, the general stagnation of the jobbing foundry has been such that, over a number of years, few if any apprentices have been trained. This will cause a shortage of skilled operatives if, and when, trade becomes normal, whilst the few who have been trained were compelled to leave the district, during the slump, in search of permanent employment.

During the latter part of the year 1935, a mild boom in shipbuilding was experienced, which produced a state of affairs which had not been experienced for a number of years. Prior to this date the industry was in a state of stagnation, which can only be appreciated by those other districts which depend upon shipping and coal mines for orders of cast-iron goods.

It may be of interest to recall that during these lean years many foundries closed their doors, and in most cases dismantled the plant, and in the North-Eastern District it is estimated that nearly fifty foundries have gone out of business during the past few years. This economic fact might give an impression that the plants which have been able to survive should enjoy a proportionately larger share of the prosperity with a trade revival, but one or two factors have been operating in a sinister way during the lean years already referred to.

### Competition from Welding

In order of importance, the menace to the foundry trade is the fabrication of steel, and in some modern marine-engine sets, a cast-iron bedplate, columns or condenser is unknown. Undoubtedly, welding construction, as adopted since the revival of shipbuilding, has in most cases proved eminently satisfactory, and brought with it advantages in design and manufacture which perhaps could not have been incorporated had cast-iron construction been adhered to. Exact figures need not be given here to indicate this obvious loss to the foundry industry, but generally it can be said that almost 50 per cent. of the total weight of the marine engines hitherto built of cast iron by a well-known firm on the North-East Coast is now displaced by fabricated steel.

Fabrication has also been adopted by both the heavy and light electrical engineering industries, ranging from power station equipment to the manufacture of switch boxes. In fact, there are few engineering firms in the area which have not established a welding department in their regular plant. Reverting to marine-engine sets, and apart from the foregoing, the tendency now is for engineers to reduce weights and costs to a minimum, and thus the high-speed engine coupled with an exhaust turbine has been evolved. In this case, the weight of the unit is approximately one-half of that previously required to drive a vessel of similar tonnage using reciprocating engines. Omitting the turbine and the gears, the actual engine weighs about one-quarter of the corresponding reciprocating engine. All these changes have occurred in the space of five or six years.

This is undoubtedly termed progress, and the foundry trade must find new avenues for the absorption of cast-iron goods when the old usages are discarded or superseded. This is a problem to exercise the keenest interest of the trade generally, and bearing in mind the disappearance of so many foundry plants in this district, perhaps this apparent loss can now be appreciated in its true perspective.

At the present time, except for the rearmament programme, to which most firms on Tyneside are contributing in some way, engineering activity is very little better than it was twelve months ago, and it can be said quite fairly that those foundries fortunate enough to be associated with firms executing Government contracts on the naval programme or War Office supplies are busy, but others, who are dependent on merchant vessel construction or repairs, are doing little business.

### The New Trading Estate

In the case of the Wearside (Sunderland) area, the state of affairs is somewhat different. In consequence of the reopening of several of the shipyards, the foundries are kept working at full capacity, with every prospect of a continuance of work in the immediate future. However, the local foundries are looking forward with interest to the huge experiment which is being fostered by the Government and the Special Areas Reconstruction Association, Limited, by the creation of the North Eastern Trading Estate, for which 700 acres of land have been acquired in the Team Valley, near Gateshead-upon-Tyne. This is an effort to induce the lighter industries to establish themselves in an area which has hitherto been dependent on shipbuilding, heavy engineering and coal mining.

The ultimate aims of this trading estate lie 20 years ahead, but, with Government backing, the directors are erecting buildings and supplying energy and services of every sort to those concerns which establish themselves in the area.

In the process of development it is to be expected that many of these new industries will require cast-iron goods for their products, and those who can foresee the outcome of this huge scheme cannot fail to include foundry plants equipped with every modern mechanical device to aid production. In the near future it is certain that specialised foundries will find a local market for their output and also be able to compete for national requirements, as goods can be delivered to the London area by rail over-night, even when entrained in the evening, which is as quick a delivery as can be obtained by firms operating within 30 miles of the Metropolis. It is encouraging to observe, from the foundryman's point of view, that Colonel Appleyard is the chairman of the board of directors, and one so closely identified with the foundry industry for so many years will regard many of the problems to be faced with a foundryman's outlook.

### Technical Activities

The activity of the Newcastle and District Branch of the Institute of British Foundrymen is a reflection of the trade of the area in a marked degree. The maximum membership of the Branch was reached about the year 1924, since when an almost steady decline has taken place, due partly to economic conditions and partly to members, mostly practical moulders, seeking employment in other districts. This represented a serious loss to the Branch. The decline of effective membership reached its lowest point about a year ago, when the officers of the Branch decided to make a drive to resuscitate its decreased prestige and to institute a systematic recruitment of new members.

Fortunately, this almost coincided with the revival of trade in the area, and in twelve months some 50 new members had been enrolled, and the Newcastle Branch has thus received a new impetus. To retain this enthusiasm and to increase further its usefulness, it is the aim of the officials to obtain Papers containing original matter of value to the scientific progress of the industry and to observe an equal balance between practical and technical subjects.

To conclude this brief *résumé* of the state of the foundry industry in the North-Eastern area, and despite the factors which are steadily perpetrating their nefarious designs to reduce the consumption of cast-iron goods, local foundrymen are still confident that with greater knowledge of this complex material, cast iron will again come into its own as the principal material for the manufacture of prime movers.

# THE LANCASHIRE AREA

By Roy Stubbs (Past-President, Institute of British Foundrymen)

Lancashire in the minds of most people is associated exclusively with the manufacture of cotton, and it is frequently overlooked that the manufacture of engineering products is one of the most important industries of the great industrial area of Lancashire. Much of the engineering work done in Manchester is, of course, associated with the manufacture of textile machinery, but additionally engineering products of almost every kind are produced in Lancashire and North Cheshire. These engineering activities naturally embrace a great deal of foundry work, and in addition to the engineering foundries, either associated with works or operating separately, there are a number of foundries engaged in the light-castings trade, notably at Warrington, Guide Bridge, Stockport, and in many other towns.

During the year 1936 the engineering foundries, both attached and unattached, have enjoyed considerable prosperity in common with similar foundries in other parts of the country. The wave of prosperity which began some three years ago has increased to such an extent that the present position is somewhat embarrassing in certain directions. The light-castings foundries are also experiencing considerable prosperity, which in their case has been of longer duration, because, due to the building boom, the light-castings foundries did not experience the difficulties due to the depression to the same extent as the engineering foundries.

The state of trade in textile-machinery foundries to some extent is governed by the state of trade in the cotton industry, and, as would be expected, many of the textile foundries have passed through a period of very severe depression. Even these foundries, however, have experienced better conditions in 1936; some of them are exceptionally busy, and others have endeavoured to embark on other lines of manufacture, and are therefore to some extent sharing in the general prosperity of the engineering trades.

### Labour Shortage

In common with other parts of the country, the full order-books have been responsible for certain difficulties in foundry management. Although prices are somewhat better than in the days of the depression, prices of raw materials have increased considerably, and, additionally, there is a shortage of skilled moulders. The shortage of skilled workmen is certainly having a retarding effect upon development, and is frequently responsible for unavoidable delays in deliveries.

For many years Manchester has been the centre of machine-tool manufacture. During the slump, when the demand for the home market was very small, many of the local firms showed considerable enterprise and initiative, as a result of which they secured considerable orders from Russia. At present almost all machine-tool manufacturing concerns are exceptionally busy, not only with export trade but with orders from the home market, and the question of deliveries has become really serious. Electrical engineers have secured many orders from overseas, particularly from Russia during the depression period, and to-day most electrical engineering foundries are busy on orders for both at home and abroad.

Lancashire can hardly be considered a steel-foundry centre, although there are some important foundries in the area. One large firm of heavy motor-vehicle manufacturers has recently closed down its steel foundry, but the buildings have been used for extensions to their iron foundry, which is developing very rapidly.

Non-ferrous foundrywork, apart from a few notable exceptions, including the foundries attached to engineering works, is largely of a general character. The founding of light alloys has been developed to very high degree of perfection by Leyland Motors, Limited, and another firm which has made considerable success in the founding of aluminium alloys is Aluminium (Hooley Bros.), Limited.

### Plant Extensions

In general the class of work carried out in Lancashire is not of a nature which encourages foundry mechanisation. There are a few notable exceptions; several mechanised plants have been in operation for some years, and quite recently a large electrical manufacturing concern has installed a mechanised plant for the manufacture of small repetition castings. At least one firm in the area has recently installed rotary-melting plant. Apart from these outstanding developments there has been considerable activity in the installation of more new and modern machinery in many foundries, and, on the whole, the more important Lancashire foundries, both attached and unattached, are well equipped to produce their own classes of work competitively both with regard to price and quality.

The Lancashire and Cheshire foundrymen have always been keenly alive to the importance of technical development, and they are fully appreciative of the value of interchange of ideas and opinions. The organisation which forms the medium of such interchange of ideas, and which is one of the media where information on technical development is disseminated, is the Institute of British Foundrymen, and the Lancashire Branch of this organisation is the largest of this Institute's Branches. Its members are drawn from all parts of Lancashire and Cheshire, and additionally it has sections at Burnley and Preston, and a junior section which meets in Manchester.

### Technical Development

The Papers which are discussed by the Lancashire Branch, although technical, are usually of such a type that the information can be readily applied in practice, and the application of technical development has always been very much in front of those responsible for the conduct of the Lancashire Branch of the Institute.

Visits to important foundries, not only in the area but in other districts, have been an important feature of the programme for years, and during the past few months over 100 members travelled to Dagenham to visit the Ford Motor Company's foundries, and quite recently about 60 members inspected the foundries of the Staveley Coal & Iron Company.

The Branch has always realised the importance of training the young foundryman, and training him on modern lines with a view to providing the future personnel of the industry, both supervisory and operative. To this end many of the firms in the area take considerable trouble in training their apprentices. Technical classes in foundry subjects are held in several towns, some of them with the active co-operation of the Lancashire Branch, and the Institute's Junior Section provides a useful medium for them to meet experienced foundrymen and to express themselves in discussions on subjects of value to them, both now and later in their careers.

What of the future? Happily, there is reason to believe that British industry, at the dawn of another year, can look forward to continued progress. The immediate signs are favourable and in trade and commerce a spirit of confidence prevails. Money is cheap, and the nation is resolved to press on vigorously with a far-sighted development of its resources. If this spirit of vigorous initiative, combined with statesman-like moderation, continues to dominate our actions and our aspirations, we may hope that, having already set the pace in industrial recovery, we may achieve still higher standards of prosperity for the nation and happiness and contentment for its people.

# SOUTH WALES

By W. E. Clement (President of the Welsh Engineers' and Founders' Association)

The trade improvement in the country generally has not been shared by South Wales foundries. Foundries making ingot moulds have certainly been busier in consequence of there having been more steel furnaces in operation this year, but the foundry in Ebbw Vale has been closed down to make way for the new continuous strip mill.

The tendency in the tinplate industry has been for the big groups to concentrate in selected works, thereby keeping down costs and obtaining the full advantages of the quotas of the works kept idle, and in spite of the increase in tinplate production no more plants have been in operation, and there has been no more work for foundries.

The roll foundries have been very quiet, as better methods in rolling practice and the improved quality of rolls have resulted in fewer rolls per mill being used.

In West Wales nearly all the iron foundries are working on short time, and the only foundries on full time are those operated by the big steel and tinplate groups.

Work for the Air Force and Admiralty appears to be confined to one or two works in the Cardiff district. Other works have been visited by Government officials, and in some cases they have been put down on the list for one or other of the three services.

Far too much under-cutting in prices, particularly in the cheaper lines of castings, exists. This is due partly to the little demand and to small foundries run by members of the same family who work hard, give good output and appear to be content with a good wage return, and are indifferent to securing a profit which will allow for maintenance and equipment of their foundries, and with no thought of expansion.

This is, indeed, a depressing picture, but quite true. Lack of enterprise is largely responsible for the present state of affairs.

# GLASGOW AND SOUTH-WEST OF SCOTLAND

By Daniel Sharpe (Past-President, Scottish Branch of the Institute of British Foundrymen)

During the past year the foundry activities in Glasgow and the South-West of Scotland have gradually become more and more intense. When the year started quite a number of the marine shops and the heavy iron-foundries were finding difficulty in getting a sufficiently large volume of orders to maintain regular production. An improvement in trade during the early months, which fortunately developed gradually, has been felt throughout the industry, and because of the gradual nature of the increase it has been reasonably easy for foundry executives to build up depleted staffs, and during the course of between six and nine months to convert their foundries into fully employed shops.

In the marine-engine shops conditions had definitely improved during last year and a large number of men who had been unemployed were

(*Continued on facing page.*)

# The Foundry Industry Month by Month

### January

RESTORATION to some 33,000 workers in the light castings industry of wage cuts—made in 1928—was announced.

LORD HIRST OF WITTON was nominated President of the Federation of British Industries.

NEARLY 100 PERSONS were elected to the various grades of membership of the Institute of British Foundrymen.

A COMPTOIR OF BELGIAN FOUNDRIES was formed to co-ordinate the commercial and technical practices of the constituent members.

AN INGOT MOULD, weighing between 165 and 170 tons—described as the world's largest ingot mould—was made by the Brightside Foundry & Engineering Company, Sheffield, for the English Steel Corporation.

THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION appointed Mr. John D. W. Davis as the new secretary.

FOLLOWING THE DEATH of His Majesty King George V on January 20, a message of sympathy was sent by the Institute of British Foundrymen to Queen Mary. Messages of sympathy from a number of foundry associations overseas were received by the Institute.

THE FARADAY MEDAL of the Institution of Electrical Engineers was awarded to Sir William H. Bragg.

### February

COLVILLES, LIMITED, acquired the Steel Company of Scotland, Limited.

THE MANCHESTER AND DISTRICT IRONFOUNDERS EMPLOYERS' FEDERATION held its annual meeting under the chairmanship of Mr. R. B. Wolfe.

A FIVE-YEAR AGREEMENT between South African iron and steel producers, the International Steel Cartel and the British Iron and Steel Federation was signed in London.

OVER 200 PEOPLE were present at the annual dinner of the Lancashire Branch of the Institute of British Foundrymen.

THE ENGINEERING SECTION of the British Industries Fair was held at Castle Bromwich, Birmingham.

MR. S. OSBORN was elected President of the Sheffield and District Engineering Trades Employers' Association.

### March

MR. FRED CLEMENTS, director and general manager of the Park Gate Iron & Steel Company, and author of "Blast-Furnace Practice," was awarded the Bessemer Gold Medal of the Iron and Steel Institute.

MEMBERSHIP OF THE Ironfounding Workers' Association was 9,566 at the end of 1935, according to the 47th annual report.

MR. FRANK BIGGIN, who was connected with the Brightside Foundry & Engineering Company, Sheffield, for over 50 years, died at the age of 68.

THE DEATH OCCURRED of Mr. J. B. Neesham, one of the pioneers of moulding machine design. He claimed to have operated the first pneumatic moulding machine in this country (in 1902).

SIR AUSTEN CHAMBERLAIN was the chief guest at the annual dinner of the British Iron and Steel Federation in London.

MR. FRANK HUDSON was elected President of the Scottish Branch of the Institute of British Foundrymen, in succession to Mr. Daniel Sharpe. The John Surtees Gold Medal was presented to Mr. Matthew Swain for a Paper on "Fabrication as a Competitor to the Foundry."

THE ANNUAL MEETING of the Foundry Trades' Equipment and Supplies Association was held under the presidency of Mr. G. T. Lunt. Membership stood at 24 and the subscription showed an advance. Reference was made in the annual report to the fact that the Foundry Trades' Exhibition, held the previous year, in conjunction with the Shipping, Engineering Machinery Exhibition, did not receive as extensive support from members and foundry-equipment manufacturers as could have been wished. It was decided to support the next Shipping and Machinery Exhibition, at Olympia, in September, 1937.

THE MANCHESTER ASSOCIATION OF ENGINEERS celebrated its 80th anniversary on March 27.

AN EAST ANGLIAN SECTION of the London Branch of the Institute of British Foundrymen was formed at a meeting of foundrymen in Ipswich. Mr. F. O. Blackwell (London Branch-President) presided, Mr. T. Makemson spoke on the aims and activities of the Institute, and a Paper on the development of cast iron in the past quarter of a century was delivered by Dr. A. B. Everest.

THE MONTH'S PRODUCTION of steel ingots and castings, amounting to 980,100 tons, was the highest on record.

MR. MAURICE WERTS was elected President of the French Foundry Technical Association, succeeding Mr. E. Ramas.

MR. S. SOUTHCOTT was elected President of the Wales, Monmouth and West of England Branch of the Institute of British Foundrymen.

### April

MR. JOSEPH HEPWORTH, M.P. for East Bradford, was elected President of the West Riding of Yorkshire Branch of the Institute of British Foundrymen.

MR. G. W. BROWN succeeded Mr. G. M. Callaghan as President of the Birmingham Branch.

MR. V. DELPORT was elected President of the London Branch, and Mr. J. Roxburgh President of the Sheffield Branch.

MR. J. HOGG became President of the Lancashire Branch.

FIFTEEN OF THE 30 blast furnaces in blast on the North-East Coast were being operated by Dorman, Long & Company.

LORD INVERNAIRN—formerly Sir William Beardmore—died in his 80th year. He was a director of several coal and engineering companies, and was chairman of William Beardmore & Company until a few years ago, when he retired. He served as President of the Iron and Steel Institute in 1917.

THE INSTITUTE OF BRITISH FOUNDRYMEN elected 71 new members at a Council meeting in Middlesbrough.

THE CHANCELLOR OF THE EXCHEQUER, in his Budget speech, announced that a £1,000,000 company would be formed to finance small businesses in the Distressed Areas.

MR. HERBERT ARNOLD SMITH, of Halifax, who was President of the Northern Brassfounders' Association for ten years, died at the age of 63.

THE DEATH OCCURRED of Mr. W. J. Flavell, J.P., of W. J. Flavell & Company, patternmakers, of West Bromwich, a Past-President of the Birmingham Branch of the Institute of British Foundrymen.

### May

SOME 400,000 TONS of shipping was being constructed on the Clyde at the beginning of the month.

THE ANNUAL MEETING of the Iron and Steel Institute was held in London. Report of Council stated that the total membership on December 31, 1935, was 1,915—practically no change from the year before. References were made by the President (Sir H. C. H. Carpenter) to the possibility of co-operation with other associations (particularly the Institute of Metals), and by the Hon. Treasurer (Mr. James Henderson) to a plan to stimulate membership. Mr. Fred Clements was presented with the Bessemer Gold Medal. At the annual dinner of the Institute the principal speakers were the Minister of War (Mr. Duff Cooper), Sir William Larke, Mr. John Craig and the Earl of Crawford.

DR. J. D. POLLOCK was elected President of the British Acetylene Association at the 35th annual meeting.

THE CRITICAL STATE of the iron-foundry industry in Holland was stressed by speakers at the annual meeting of the Association of Dutch Iron Foundries.

MR. GEORGE ERNEST WELLS joined the board of Kryn & Lahy (1928), Limited, the Letchworth steel founders.

MR. J. R. WINPENNY, for many years secretary of the North of England Iron and Steel Manufacturers' Association, died in his 88th year.

THE AMERICAN FOUNDRYMEN'S ASSOCIATION elected Mr. James L. Wick, Jun., as its new President.

MR. L. J. TIBBENHAM was elected as the first President of the new East Anglian Section of the Institute of British Foundrymen.

MR. EMIL RAMAS, an outstanding figure in international foundry activities, died. He was made an honorary member of the Institute of British Foundrymen in 1922.

### June

MR. A. H. GUY, President of the Transvaal Engineers and Allied Metal Trades' Federation, on a visit to this country, was the guest at a luncheon given in his honour in London.

## District Foundry Activities Analysed by Experts—(*continued.*)

### Glasgow and South-West of Scotland

(*Continued from previous page.*)

re-absorbed into industry. Some of the largest Clydeside foundries catering specially for shipbuilding are now working under great pressure, but even at this stage there is no serious indication of undue delay in delivery, indicating that the district is well provided with foundry capacity for its requirements. The position has been somewhat relieved by the fact that the foundries on the North-East Coast did not feel the increase in work quite so soon as the Scottish foundries did, and a large number of castings were imported into the area from that district.

Steel foundries in this area are at present fully employed, and they have enjoyed full order-books during the greater part of the year.

### Non-Ferrous Foundries

The non-ferrous foundries in this area are similarly situated and are now working under very great pressure. Engineers in the Clyde area depend to a considerable extent on bringing non-ferrous castings from the South, and no apparent difficulty appears to exist in obtaining satisfactory supplies.

In the light-casting industry work has been ample to keep all the foundries fully employed during the whole year, and the promise for the early part of next year indicates no slackening of demand for some considerable time. Much discussion has taken place regarding developments and extensions to foundry plants, but so far no major foundry reconstruction has occurred during 1936, except perhaps G. & J. Weir, Limited, and Babcock & Wilcox, Limited. Many plants have added to their buildings, but a more definite development has taken place in the introduction of labour-saving schemes within the existing foundries. These consist of transport, sand handling and preparation plants and moulding equipment, and the inquiries being received at the present time would indicate that many foundries which have been contemplating mechanical aids to production feel that they are now justified, by the volume of business offered, to proceed with schemes which have been latent for a number of years past.

With regard to labour in the Glasgow district, this has been found ample up to the present time and no undue competition for labour has been noticed. This, again, indicates the benefit that has been derived from the gradual increase in trade.

During last year the activities of the Institute of British Foundrymen have been particularly lively, owing largely to the annual conference of the Institute being held in Glasgow and Edinburgh. This conference, which was held during a spell of delightful weather, has had a definitely beneficial effect on the membership, and the interest which the members are taking in the work of the Institute.

SIX HUNDRED DELEGATES representative of fifteen nations attended the twelfth International Congress of Acetylene, Oxy-Acetylene Welding and Allied Industries in London. Sixty technical Papers were discussed, and social functions included the inaugural ceremony at the Guildhall, a Government reception at Lancaster House, a banquet at Grosvenor House, a Thames river trip and a visit to the Aldershot Tattoo.

THE DEATH OCCURRED of Sir Thomas Putnam, formerly managing director of Darlington Forge, Limited.

THE 33RD ANNUAL CONFERENCE of the Institute of British Foundrymen was held in Glasgow from June 9 to 12. Mr. J. E. Hurst, the retiring President, occupied the chair at the outset, later inducting the new President, Mr. H. Winterton. Mr. C. W. Bigg was elected Senior Vice-President, and Mr. Joseph Hepworth, M.P., Junior Vice-President. Two Oliver Stubbs Gold Medals were awarded, one to Mr. F. Hudson, and the other to Mr. E. Longden. Presentation of the medals was made by the Lord Provost of Glasgow, who had the previous day received members and their ladies at a Civic Reception at the City Chambers. Mr. Hurst announced the establishment of the E. J. Fox Gold Medal, made possible through the generosity of Mr. E. J. Fox, managing director of the Stanton Ironworks Company, Limited, who had presented £500, the annual revenue to provide a medal which would be awarded to any individual "who had contributed in some outstanding way to the progress of the foundry industry, with particular reference to foundry metallurgy." Mr. Winterton discussed in his Presidential Address the directions in which the industry was progressing, and referred also to the origin of the art of ironfounding in Scotland. The annual banquet and dance was a very successful function, many distinguished guests being present. One of the principal speakers was Sir James Lithgow, President of the Reception Committee. The Edward Williams Lecture was given by Prof. A. L. Mellanby, D.Sc., who spoke on "Cast Iron and the Engineer." Ten Papers were presented at the Conference, including Exchange Papers from France, Germany and America, and two Technical Sub-Committee Reports. The closing event of the Conference was a whole-day excursion by steamer to the Isle of Arran.

THE BRITISH IRONFOUNDERS' ASSOCIATION met to consider the question of art in the light-castings industry, and the facilities available to secure expert draughtsmen-designers for the future.

THE ANNUAL REPORT of the British Non-Ferrous Metals Research Association disclosed excellent progress in every direction.

LORD LONDONDERRY opened the new spun-iron pipe plant at the Ormesby Ironworks of Cochrane's (Middlesbrough), Limited. Pipes from 3 in. to 24 in. diameter and 12, 18 or 21 ft. long can be produced.

LABOUR UNREST caused the postponement of the 15th annual congress of the French Foundry Technical Association.

A FORMER MASTER CUTLER OF SHEFFIELD and chairman of Samuel Osborn & Company, Limited, Mr. W. F. Osborn died in his 76th year.

THE CHEMICAL ENGINEERING CONGRESS of the World Power Congress was held in London.

THE DEATH OCCURRED of Mr. E. P. Taudevin, the well-known furnace designer.

### July

THE FIRST WORKS VISIT of the East Anglian Section of the Institute of British Foundrymen was to the Ipswich works of Ransomes & Rapiers, Limited.

THE MEEHANITE INSTITUTE met in London, and discussed 35 technical Papers in one day!

MR. ALFRED HUTCHINSON, M.A., was nominated President of the Iron and Steel Institute, to take office in 1937 on the retirement of Sir H. C. H. Carpenter. The Earl of Dudley was nominated President to take office in May, 1938.

G. & J. WEIR, LIMITED, the engineers and founders of Cathcart, celebrated its 50th anniversary. Every employee over 21 received 10s., and those under 21, 5s.

A LEAD INDUSTRIES DEVELOPMENT COUNCIL was formed to promote new and improved methods of using lead and lead products.

THE GOVERNMENT sanctioned the advance of moneys for the construction of a sister ship to the "Queen Mary."

THE BRITISH FOUNDRY SCHOOL held its first annual general meeting in Birmingham. The Report stated that 13 students enrolled for the first session of the School.

THE ACQUISITION of the ordinary share capital of the Lanarkshire Steel Company, Limited, by Colvilles, Limited, was announced.

FOR THE FIRST TIME since November, 1930, exports of U.K. goods exceeded £40 million in value.

### August

"THE FOUNDER ON HOLIDAY," title of a leading article published in the JOURNAL at the beginning of the month, strikes the dominant note of the month.

MR. THOMAS RITCHIE, head of Anderson & Ritchie, one of the best-known foundry concerns in South Australia, paid a visit to Falkirk. Born in Carron, he emigrated to Australia in 1889.

ANOTHER LARGE INGOT MOULD, weighing over 150 tons, was cast by the Brightside Foundry & Engineering Company, Sheffield, for Thos. Firth & John Brown, Limited.

### September

THE CRICKET MATCH between the Institute of British Foundrymen and the Birmingham Branch of the British Works Managers' Association resulted in a victory for the foundrymen, who scored 89 runs against their opponents' 52.

SOME 2,200 FOUNDRYMEN attended the International Foundry Congress which was held in Düsseldorf. The British delegation numbered over 100. The opening ceremony, at which Mr. W. Bannenberg presided, included an address by Dr. Schacht, Germany's Finance Minister.

IN ADDITION to many works visits (including the special one of members of The Institute of Vitreous Enamellers to the Rhenania enamelling works at Schwelm) and technical sessions, a varied programme of social functions was arranged, delegates being entertained at the Zoological Gardens one evening and at a mediæval castle the next. In scope the Foundry Exhibition held in conjunction with the Congress was the most complete that has ever been organised; the technical exhibits, particularly, were illuminating. The Lancastria Club held its eleventh annual banquet during the Congress.

THE BELGIAN FOUNDRY TECHNICAL ASSOCIATION commemorated its 25th anniversary on September 25.

THE IRON AND STEEL INSTITUTE held its autumn meeting in Düsseldorf. The last visit of the Institute to that city was in 1902.

THE DEATH OCCURRED of Henry Le Chatlier, famous French scientist. His pioneer work on the microscopy of metals made his name internationally respected in metallurgical circles. He rendered outstanding service, too, in connection with the safety of coal mines.

THE PRODUCTION of steel ingots and castings in September exceeded 1,000,000 tons.

### October

COMPLETE REORGANISATION of the Paris Foundry High School, to be introduced at the end of the year, was announced. Prof. Albert Portevin was nominated as the successor to Mr. E. Ronceray (who is retiring) as director.

A CONFERENCE in London resulted in an agreement to reduce the working hours of blast-furnacemen in England and Wales from 54 to 48 a week.

THE THIRD ANNUAL CONFERENCE of The Institute of Vitreous Enamellers was held in Manchester. About 130 members attended the banquet. In his Presidential Address Dr. J. W. Mellor outlined the steps which had been taken towards the formation of a research association. Mr. W. H. Whittle (Chairman) was able to report a substantial increase in membership, as well as a continuance and development of the Institute's activities. Revisions of the articles of association were approved at an extraordinary meeting, and at the technical session a Paper on "Modern Tendencies in Vitreous Enamelling" was presented by Mr. S. Hallsworth.

NEW LABORATORIES of the research and development department of the Mond Nickel Company, Limited, were opened in Birmingham.

SEVENTY NEW MEMBERS were elected at a Council meeting of the Institute of British Foundrymen.

### November

THE RT. HON. THE EARL OF DUDLEY, M.C., was elected President of the British Cast Iron Research Association at the annual meeting, in succession to Major F. A. Freeth. Lord Austin was elected a Vice-President. The annual report of the Association disclosed a record income for the year. There were 308 ordinary and trade members and 56 associate members.

A JOINT MEETING of the Iron and Steel Institute and the Institute of British Foundrymen discussed sections of the Second Report of the Steel Castings Research Committee.

THE DEATH OCCURRED of Mr. Sidney Evans, a well-known figure in foundry equipment supply circles.

### December

THE ANNUAL DINNER of the British Ironfounders' Association was held in London.

MR. IAN S. OSBORN, a director of Samuel Osborn & Company, Limited, the Sheffield steel founders, died at the age of 36.

## New South African Tender Regulations

Notice No. 1597, published in the South African Official Gazette, contains the newly-approved regulations governing the constitution and operation of the Union Tender and Supplies Board. These regulations involve certain changes in the procedure previously adopted in the issue of calls for tender for Government supplies, and are of interest to United Kingdom firms wishing to submit offers as occasion arises.

The effect, where United Kingdom firms are concerned, of the changes referred to will be as follows:—(1) Tenders will now be called for in the Union only, and Union officials in the United Kingdom will cease to advertise such calls in this country; (2) tender documents will now be available at the office of the High Commissioner in London for the Union of South Africa for inspection purposes only, and copies will not be provided, as before; (3) calls for tenders will be advertised in the South African Government Gazette, and firms within the Union will not be advised of such calls direct, but must assume responsibility for ascertaining the details of all inquiries themselves and of applying for copies of tender documents.

The effect of sub-paragraph 3 above will be that it will be almost essential for United Kingdom firms desirous of procuring details of calls for tenders issued by the Board to be represented in the Union. In this connection the Department of Overseas Trade informs us that it will be pleased to assist firms desirous of tendering for the supply of material of United Kingdom manufacture, and not represented in the Union of South Africa, by endeavouring to place them in touch with suitable agents.

## Catalogue Received

**Pulverising.** We never remember having impressed upon our minds so clearly the number of methods available for pulverising coal as does a catalogue recently received from the British Rema Company, Limited, of Halifax. Ring, roll, tube and ball mills are all illustrated and described, as well as a disc and pinned cage mill, which internally resembles sand disintegrators, though apparently they are used for dyes, cocoa, resins, talc and similar soft materials. Pulverised fuel firing systems are shown, one in conjunction with a 10-ton Brackelsberg installed in the works of a subsidiary company. We were hoping to see illustrated a plant for mixing blackings which we seem to remember functioning very well in the works of this company. The catalogue (No. 19) runs to eight pages, and is well illustrated.

# A Layman Looks at Bath-Making from Cupola to "Bakery"

## By SYDNEY WALTON, C.B.E., M.A., B.Litt.

*Foundrymen must have often wondered just how their workshops look to the complete layman, and as there is a Scottish dictum which postulates "Oh wad some power the giftie gie us to see oursels as others see us," Mr. Sydney Walton, the well-known essayist and author of "The Sieve of Blindness" and "Lotus Leaves," kindly consented at our request to visit the foundry of the British Bath Company at Greenford and record his impressions.*

RIGHT well the Editor knows I am no technician. Nor can I claim to be any good with my hands, as the saying is. But these defects deterred him not at all; he persisted with his persuasions, said some of his readers might even be interested to see a foundry through non-mechanical and unscientific eyes like mine. There's Yorkshire in him, I surmise, or perhaps the fine stubbornness of the Scotch. He simply would not be put off. So in the sunshine of a January morning, a day set as silver amid sombre vessels of mist and rain, I did the short, swift journey to Greenford, in Middlesex, from my home on Harrow Hill.

In that exalted school on the comely summit baths were not always as plentiful as to-day they are; nor of course were they plentiful in the homes of our forbears. Concern for personal cleanliness and public health has spread through Britain like purifying fire and fragrance in recent decades. I sometimes think that the heavy industries seem not to be very aware of the debt they owe to the change for good in the habits and desires of the people. Prof. G. M. Trevelyan, an Old Harrovian by the way, comments in his famous History of England that the social chronicles over a period of certain centuries might have been written in terms of wool. In terms of iron and steel the break with tradition in domestic architecture and comfort has expressed itself. Blessed the man who made two baths grow where was only one before! Only we must not be vainglorious and boast; I recall a visit to the marvellous ruins at Knossos in Crete, where Sir Arthur Evans has unfolded a civilisation more ancient and far more dainty than Homer's. Not again until, perhaps, the nineteenth century were such exquisite domestic amenities known.

January sunshine enamelling (it could be the technical term!) the neat, spruce, comely works of the British Bath Company at Greenford. Even before I cross the railroad to enter the official gate my impression of the works is agreeable, genial, good. Pleasant to see a place of industry cared for and decently groomed, a sense of citizenship about it, a desire not to annoy one's neighbours, as industrial ugliness used to annoy the soul of John Ruskin. One of the major revolutions since I was a boy in County Durham is the transformation of the factory; then grim and forbidding, proudly asserting "dirt is money and grime is gold," now as at Greenford (and elsewhere in the South) something of a palace, something indeed of a cathedral as is the Battersea Power Station on the farther bank of the Thames. Works architecture has profoundly and beneficently changed. In a single glance I note the thoughtful planning of the Bath Company's place at Greenford, nothing casual and chanceful, nothing higgledy-piggledy. "In the mind of a man the building grew and was shaped by his dreams before the foundations were laid and roof and rafters crowned the structure."

I meet Mr. A. Young, and forthwith he sends a message to Mr. W. D. Muirhead, whose jurisdiction is the works. Mr. Young senses at once my technical ignorance and is forgiving. History, romance, legend: these hold me in thrall, and I ask about the antiquity of foundries, whereupon Mr. Young produces some old prints on which to feed and pasture my longing soul, and his office gives place to a delectable bit of Britain by the Severn, and with wonder-eyes we look upon the Iron Bridge near Coalbrook Dale in Salop, where was the cradle, I gather, of the foundry industry, a cradle among trees, with the sweet river as lullaby. Rich old prints, matured wine of artistry, autumn-leaves from the yester-years, documents of the early beginnings; Mr. Young did well to show me the ancient episodes before we make our pilgrimage to the modern activities.

Our pilgrimage begins at the cupola, of course. I like the name, I think of the Inigo Jones

MR. SYDNEY WALTON, C.B.E., M.A., B.Litt.

cupola in the Barber-Surgeons' Hall in Monkwell Street in the City, I recall cupolas in churches, we begin in a golden light of poetical remembrance. Here issues the fiery molten metal, a stream of flame, issues into great cups on wheels, issues crimson and glowing, issues to take the shape and symbol of man's thought. Never do we know what reverberations the usual and commonplace may awake in a visitor's memory. Limestone I see around me, limestone brought here as flux for the furnaces, and at once I am back in Weardale, where I was born, Weardale of the limestone quarries, which are open in the hills like wounds unhealing and irreparable. Merely little heaps and clusters of limestone at Greenford, and they are a magic carpet transporting me to the moors and the heather, to the snows and the primroses. From the fat, staid, solid cupolas, which appear with smug smile to say, "Without us, gentlemen, what could these works do, though they be acres-long"; from the plump and corpulent cupolas "whose saliva is gold" (as a poet says), we pass into the dark-sanded avenues of the moulding floors. Yonder at the furthest end beyond the gleams of the obedient rivers of fire is the gentle flash of the welding, but here at my feet the black dust, a Sahara literally Ethiop, and the buxom moulding-boxes (flasks they call them in U.S.A.), and the occasional polished patterns, arbiters of the scheme of things, and barrow-loads of "hot headers," which give the hint of treasure-trove, the hint of passion at flowering point.

Like Rudyard Kipling I am sensitive to scents and odours. According to him, you can tell cities by their smells, distinguishing Rome from Naples, Constantinople from Cairo though you be blindfold. Sailing down the Thames I enjoy "this pastime of the nostrils," and can point out without seeing: "There tea is stored" and "Here oil waits to be sent to market," and so on. In this dusky avenue at Greenford, the black sand at my feet, the dust-rain of industrial activity, there's the odour of iron-warmth, the smell (agreeable I find it) which fills the air when iron sizzles. I recognise it as an old friend which first I met in the Rise Carr Rolling Mills in Darlington years ago, the odour of warmth contrasting with the clear crisp January air outside.

Mr. Young hurries me on to meet Mr. Muirhead and, through a harsh cataract of noise as of giants gnashing their teeth or sharpening them on volcanic stones—"These are the grinders," shouts Mr. Young—we pass to the sand blasting, leaving the din and dissonance behind, and then to the enamelling. The difference between the long dark Ethiopian-like lane of moulding and casting, dark save when the fires flash and the metallic-lava glows, and this present whiteness captures my attention and fancifully I begin to think of the British Bath Works at Greenford as holding two hemispheres in one, the hemisphere of night and the hemisphere of day. So white this portion of the works that it might be a bakery, with the baths resembling Titanic loaves, and the enamel not resembling flour but being itself flour; white, everything white, why even the baths are at white heat to take on their final finished and shining whiteness. If the moulding-room is the gloaming, here is the full noonday; if that be a black Sahara this surely is the true Sahara white with the bleaching of the desert-sun. I might be a boy again for my delight in the Bath-Bakery, as I will call it; the batteries of enamel and enamelling furnaces like ovens, and the enamellers clad like bakers, and the floors white with their enduring flour.

Finally into the cool passivity of the place where the finished baths stand upright, row upon row, white-bosomed, waiting for wagons to take them into domestic permanence in what parts of Britain I know not. I am writing at this moment in Edinburgh. It is the morning, the early morning of the next day, and the light of dawn comes slowly over the ancient Castle high on the great rock and soon will be going down the Royal Mile with gentle and delicate steps, brushing the darkness aside. I've been in the train the night through, and until I've had my bath I shall feel the fatigue of wheels. Yesterday morning I saw baths being made, and a fascinating process I found it to be. Now I shall plunge into the finished product and emerge rejuvenated like the dawn!

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COL. COLVILLE, Financial Secretary to the Treasury, speaking at Edinburgh last week, said that all the available data pointed to a continuance of the upward trend in our trade as a whole if only European peace could be preserved. The confidence of the business community in the home market was unimpaired. Raw material imports were increasing; money was being spent more freely.

# The Non-Ferrous Metals in 1936

## RISING PRICES IN ALL MARKETS

### (By Our Metal Exchange Correspondent)

THE year just concluded has been marked by a considerable expansion in the use of the non-ferrous metals, for consumption has improved very much all round, and in every case it has been found necessary to increase the rate of production in order to cope with this change to what, during the concluding months of the year, were almost boom conditions. In these circumstances it is obvious that prices must also have improved, and improved they have in no uncertain manner, the levels reached in many cases only being matched by those ruling during the period before the bottom dropped out of things in the autumn of 1929.

Last year will be notable as the transition period when commodity prices moved up to new levels, for it became obvious after the first six months that the rise in values was no mere flash in the pan, but a definite change to a fresh valuation which turned its back on the starvation prices seen in 1932. The second half of the year was marked by a wave of tremendous optimism regarding commodity prices generally, and it was noticeable that abandonment of the gold standard by France and other members of the gold *bloc* acted as a spur to speculative buying, which did so much to push values up both too fast and too far, although it must be admitted that the reactions were not particularly serious. Consumers have been very much puzzled by the sharp rise in values during 1936 and they look forward to 1937 with a certain amount of apprehension, for at the back of their minds is the thought that this has happened before, and has been followed by a disastrous slump.

#### Poor Opening in Copper

The opening of the year for copper was not a very auspicious one, for all the metal markets were rather upset by the collapse in silver, Sir Samuel Hoare's resignation and rumours of strife and disagreement in the Cabinet. Moreover, the statistical position was not looking too good, hope of an advance beyond 9¼ cents in the United States had been abandoned, although it was thought that eventually 10 cents would be reached, and consumers were very much on the defensive. For inventory purposes the price had been pushed up over the turn of the year and January saw the usual downward slide following this rise. However, towards the end of the month rather a better tone developed as the stocktaking period finished, and the market began to improve to some extent. The year opened with standard at £35 for cash and wire bars at £39 7s. 6d., but the second half of February saw an advance to £35 17s. 6d. and £40 10s., while a few days later Phelps Dodge and Anaconda advanced their selling limit to 9½ cents. This caused a minor flurry on the Metal Exchange, but the improvement was short lived, for with Kennecott and some other producers still prepared to sell at 9¼ cents the bull movement lost ground. By early March standard was at £36 7s. 6d. and wire bars at £41, while the levelling up of the American domestic price at 9½ cents at Easter brought a further rise in London to £37 11s. 3d. for standard and £42 for wire bars.

This improvement was not, however, of long duration, for the trend of the statistical position was not too good and stocks were increasing; consumers bought, but not very freely, and on the Metal Exchange there were some days when business was very quiet indeed. On June 11 standard was back to £36 2s. 6d. and wire bars to £40 10s., while at the end of that month there had been an advance of about 10s. Actually, the three months from Easter were a dull period for copper, and in the light of what happened in the autumn months, the policy of inaction pursued by buyers proved to be decidedly wrongheaded. This is all the more curious as it was announced in April that the curtailment scheme would be continued until the middle of 1938, but there had been some hedging buying from France against currency fears and possibly consumers here feared resales. Whatever the reason trade buyers during those three months were not inclined to take a bullish view of the future, although it was generally admitted that the chances of any serious setback were small. The political situation on the Continent, and particularly in Spain, was, of course, a marked deterrent to optimism, except in so far as the shadow of a general European conflagration encouraged a small body of bull speculators.

#### Change in Last Six Months

Towards the end of July a change came over the market, for the American domestic price was lifted to 9¾ cents, and it became evident from the volume of buying before the advance that conditions in the United States had very much improved. Just prior to this advance activity increased on the London market, standard advancing to £38 for three months and wire bars to £42. At the same time, came an announcement that the affiliated producers intended as from August 1 to increase their rate of production by 5 per cent., and on this news the market reacted slightly, but the setback was short-lived and by the middle of the month standard was up to £39 and wire bars to £43 10s. Contrary to its reputation, and in spite of much uneasiness over the Continental position, August was proving to be anything but a holiday month so far as markets were concerned. Speculators entered the market and the weekly turnover in standard began to increase in consequence, while there was also some talk of near-by electro not being too plentiful. The export price in the United States advanced in line with London, and on September 7 it actually passed the domestic quotation, being quoted at 9.77½ cents c.i.f. Towards the end of the month France and the other gold *bloc* countries devalued, and on September 30 standard was £39 6s. 3d. and wire bars £44 5s., a spread of £5.

Liquidation of copper holdings by French interests was feared, but in any case buyers predominated on 'Change and by mid-October standard was at £41 and wire bars at £45 15s., the export price being 9.92½ cents c.i.f., while on October 26 these lined up at £42 3s. 9d. standard, £46 15s. wire bars, and 10.20 cents c.i.f., the domestic quotation being still 9.75 cents delivered Valley. On October 27 the American producers advanced to 10 cents after having sold a very big tonnage at 9¾ cents. Early in September another 5 per cent. increase in production had been announced, this to take effect from October 1, and in an attempt to prick the bubble of inflation, which was pushing prices up too fast and too far, two further additions to output, totalling 15 per cent., were announced in October. This, however, only served to add fuel to the speculative flames, and the advance to 10 cents domestic was also interpreted as a bull move, for prices in London went ahead again, three months standard reaching the top on November 6 at £45 2s. 6d. during the period of the Presidential election, while three days later wire bars were hoisted to £50, following an advance in the American domestic price to 10½ cents. £50 was equal to 10.85 cents c.i.f. but the market was looking decidely tired after its long upward climb, and with Wall Street beginning to suffer from "second thoughts" about the election result standard copper had a bad attack of nerves and heavy liquidation was seen, which carried the price of three months down to £42 10s., wire bars coming down to £48. That, however, proved to be the bottom, and although consumers bought rather sparingly and the market turned very quiet, a recovery of about £1 occurred. December was overshadowed by the Constitutional crisis, but the second half of the month brought a further inrush of buying orders from speculators, carrying prices to the highest point touched during the year, viz., £54 10s. for wire bars.

#### Tin Production Increased

Two main influences were discernible in tin last year, the quota question during the first part, and thereafter doubts as to the continuation of the curtailment pact. The year opened with cash tin at £218, three months being £10 lower, and the quota had recently been lifted to 90 per cent. Under the influence of the adverse factors which affected copper, cash declined to £201 10s. on January 27, but picked up to £209 by the end of that month. On the whole, February showed a firm trend, for on the 19th of the month the quota was reduced to 85 per cent., although at that time stocks in the United Kingdom were only about 600 tons. March brought the disastrous floods in the U.S.A. and cash, after touching £217 on the 16th, declined to £211 10s. by the end of the month, losing further ground in April to £208. In the States matters got back to normal and tinplate activity was running at about 80 per cent. of capacity. In May values began a retrograde movement. Three months tin had been below £200 in January for the first time in two and a-half years, but on May 29 the market stood at £195 15s. cash and £192 for three months. June was a very weak month, as there were uncertainties about the third-quarter quota, and the question of continuation of the curtailment scheme was also to the fore. By the middle of the month three months tin was under £180, and on the 26th, following an announcement by the Tin Producers' Association that the quota would be raised to 90 per cent. again, the market broke sharply to £176 10s. for cash and £174 10s. for three months, some recovery being seen by June 30. Following on this setback and helped by the fact that America came in as a buyer at the lowest levels, matters improved considerably in July, £193 15s. for cash being reached in the middle of the month.

This really proved to be the turning point in tin, for negotiations had begun with Siam over the vexed question of curtailment, and in August it was reported that a representative of Siam was on his way to London. Throughout August the market was fairly steady, being under the influence of the waiting policy adopted by operators generally, but in September a firmer tone was apparent and by the end of the month cash stood at £204 and three months at £200 5s. In October, with discussions still dragging on, the market showed a slightly easier tendency, for Siam was still holding out for a high quota and, just as earlier in the year uncertainty about the Bolivian arrears upset confidence, so now the vexed question of whether or not Siam was staging a bluff kept people on tenterhooks. However, at the end of October values had advanced to £210 for cash and by November 4

another £8 had been added to the price. On the following day, after the midday market, it was announced that agreement had been reached, and a swift upward movement culminated on November 10 with cash at £244 15s. and three months at £241 15s., following which there was a pretty severe setback, mainly due to the announcement that for the last quarter the quota would be 105 per cent., retrospective to October 1. The November figures showed an increase of approximately 4,000 tons in total visible supplies, and the market, disturbed by the crisis in this country, fell £10 to £226 without operators on 'Change showing much inclination to make purchases. However, an improvement followed, the December figures showing an increase of only about 700 tons in visible supplies, and the year closed on a very steady note, with cash quoted at £235 5s.

### Strength of Lead

In the early days of January last year the lead position did not look very wonderful, for demand was poor and there was a certain amount of selling by producers on the Metal Exchange. On January 2 this metal was quoted at £15 10s., but by the middle of the month there had been a decline of 20s. to £14 8s. 9d. for spot and £14 11s. 3d. for forward, these proving to be the lowest levels touched during the year, for quite a sharp recovery followed, and by the end of January the price had climbed up to £16 5s. Towards the end of February £16 12s. 6d. was reached, as business, particularly in the building trade, began to improve, but the advance halted there, for Continental buying was on a very poor scale, and this fact undoubtedly helped to keep the London market down at a time when prospects at home began to look much brighter and a spell of excellent consumptive buying appeared likely. March and April were steady months, but May and June were poor, the quotation on May 29 being £15 11s. 3d., and at the end of June £15 2s. 6d., actually lower than it was at the beginning of the year.

As in the case of copper and tin, the second half of the year brought a higher price level, the spot quotation standing at £16 15s. on July 31 and £17 1s. 3d. a month later. Civil war had begun in Spain, consumption the world over was increasing to a marked extent, and speculators were coming into the base metals with increasing confidence. About this time it was said that lead would advance to £20, and it certainly began to look very like it, for by mid-September the price was £18 12s. 6d., although by the end of the month it stood no higher than £18. This slight reaction, however, attracted buyers, and at the end of October the quotations stood at £19 10s. spot and £19 5s. forward, the premium for early metal being an indication of some scarcity for the nearby position. In America an upward trend had developed, and the price was advancing steadily in the face of good demand by consumers, so that it was not altogether surprising when, on November 4, lead crossed the £20 line in London and was up to £21 8s. 9d. a few days later. During the whole of that month the trend of values was strongly upwards, £22 10s. being reached on November 19, and four days later £23 17s. 6d. on the afternoon session. This proved to be the top, and there was a fairly sharp reaction which took the quotation down by 12s. 6d. to £23 5s., early December, however, seeing the price 15s. lower at £22 10s. The setback did not unduly upset sentiment, for it was known that speculators were in lead and that sooner or later they would liquidate their holdings. Following this came a remarkable jump to £28 13s. 9d. by December 29, the year closing at £28 7s. 6d. Consumers held off during December and the rise was due to speculation.

### Fluctuations in Spelter

The year opened with the price at £14 5s. for spot and sentiment rather depressed, but, with consumers showing more interest, values improved, and by the end of January £15 1s. 3d. had been achieved. Buying was rather patchy, but the market was cheered by talk that the Zinc Cartel was again under consideration, and although it was realised that many difficulties stood in the way, it was hoped that a way out would be found. On February 28 the price was £16 3s. 9d., and it was known that preliminary discussions about the Cartel were taking place, but during the ensuing months spelter came under the adverse influences which proved so disturbing to the other non-ferrous metals during this period. March 31 saw the price at £15 18s. 9d., and a month later it was £1 lower, for hopes that the Cartel would stage a comeback were growing rather faint. June was a poor month, with buyers rather holding off, and by the 30th the quotation was below £14 and, in fact, no better than £13 13s. 9d. This was not the bottom of the price curve, however, for on July 10 the quotation stood at £13 3s. 9d. spot and £13 8s. 9d. forward. Later in July matters improved, and towards the end of the month there was a recovery to £14 for spot, but early in August the price trend was reversed on news that the Cartel negotiations had been abandoned.

On August 20 the price went as low as £13 7s. 6d., and it stayed below £14 throughout August and the first week in September; nor, apart from a recovery to £14 8s. 9d. halfway through that month, was there much activity until the second half of October, when a burst of speculative buying developed. This took the price up to £15 3s. 9d. by October 21 and on to £15 17s. 6d. on November 2. Four days later £16 8s. 9d. was reached, but when Wall Street boiled over just after the Presidential election, spelter slumped to £15 8s. 9d. on heavy liquidation by speculators. However, the fall proved to have been overdone, and a week later the price was back at £16 7s. 6d., then £16 13s. 9d. on the following day and £16 17s. 6d. on the midday session of November 23, with a rise to £17 5s. in the afternoon. This was the top, and certainly a good deal higher than was justified by the rate of consumption, good as it was, for when lead began to react, spelter followed, and was no better than £16 3s. 9d. on the first day of December. Under the influence of the rise in lead, however, and assisted by big speculative purchases, the quotation advanced rapidly during the ensuing weeks, reaching £20 on December 29, the year closing at £19 18s. 9d. spot.

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(*Continued from next column.*)

from the CARBORUNDUM COMPANY, Trafford Park, Manchester, a monthly tear-off wall calendar carrying a brilliant picture of the Indian's head which one always associates with their trademark; from CRAVEN BROS. (MANCHESTER), LIMITED, Reddish, Stockport, a tear-off wall calendar carrying last, this and next month on each page, at the top of which is a picture of a machine tool; from CROSSLEY BROS., LIMITED, Openshaw, Manchester, 11, a monthly tear-off wall calendar, mounted on stiff cardboard which carries illustrations of recent productions; from BLACKSTONE & COMPANY, LIMITED, Stamford, a monthly tear-off wall calendar, each sheet of which contrasts the progress effected during the hundred years of their existence. May we also extend our congratulations to this second case of an industrial century not out. From ASHWELL & NESBIT, LIMITED, of Barkby Lane, Leicester, a day to day tear-off wall calendar solidly mounted on stiff cardboard carrying a striking aerial picture of the Houses of Parliament printed in light pastel shades; from HARRIS & PEARSON, LIMITED, of Stourbridge, a monthly tear-off wall calendar mounted on cardboard which illustrates a number of typical refractory sections; from W. & J. F. JONES, LIMITED, Pendlebury Foundry, Pendlebury, near Manchester, a monthly tear-off wall calendar sur-

(*Concluded on page 77.*)

# Dates and Data

We very heartily reciprocate the good wishes which accompanied the gifts listed below, and especially those foundries in the Dominions which sent us Christmas cards and other expressions of goodwill.

### Diaries Received

Because of its unique qualities, we feel that we should first mention the diary received from J. GRAY & SONS, LIMITED, of 5, Victoria Street, London, S.W.1, who have sent us on "The Vitreous Enamellers' Diary." It is of the seven days to a page type and carries some 30 pages of technical information interspersed with a modicum of advertising pages. There is inserted a squared-paper notebook. It is an extremely handsome and useful diary which will be appreciated by all recipients. From CLEMENTS & THOMAS, LIMITED, of Morfa Foundry, Llanelly, comes a two days to the page pocket diary; from BRITISH & CONTINENTAL TRADERS, LIMITED, Lincoln House, High Holborn, London, W.C.1, a four days to the page pocket diary, containing a wealth of technical data, which we personally have invariably found to be both useful and reliable; from the STANTON IRONWORKS COMPANY, LIMITED, Stanton, Notts, a week to the page pocket diary, carrying fore and aft exceedingly clearly-printed maps of the London Underground railway system, and a supplement carrying much technical data about cast-iron pipes; from the STAVELEY COAL & IRON COMPANY, LIMITED, a combined pocket wallet and diary, which includes a removable inset containing about seventy pages of data dealing with pipes and kindred subjects; this diary has a week to the page. From JOHN G. STEIN & COMPANY, LIMITED, Bonnybridge, Scotland, we have received a waistcoat pocket diary of four days to the page, including a preface carrying a quantity of reliable data germane to the refractories industry, as well as a few well-printed maps; from the FRODAIR IRON & STEEL COMPANY, LIMITED, Fenchurch House, London, E.C., a four days to the page lightweight waistcoat-pocket diary; from the CLAY CROSS COMPANY, LIMITED, Clay Cross, near Chesterfield, a four days to the page waistcoat pocket diary, which announces the installation of a new pipe-spinning plant and reminds us to offer our heartiest congratulations to the company on reaching the centenary of its foundation in 1837. The diary is very informative, and we now know what a chord of wood, a cask of black lead, a faggot of steel and a pig of ballast are! Finally, J. STONE & COMPANY, LIMITED, of Deptford, London, S.E., have sent a sealskin bound vest pocket diary of four days to a page.

### Calendars, etc.

From DEMAG A.-G., of Duisberg, Germany, refills for their perpetual desk memorandum calendar; from WILLIAM CUMMINGS & COMPANY, LIMITED, of Glasgow and elsewhere, a perpetual desk calendar in bakelite, which, by turning a knob, indicates by means of a red circle the day of the month, whilst at the same time it erases all the yesterdays; from STEWARTS AND LLOYDS, LIMITED, of London and Glasgow, a monthly desk calendar framed in white leather and decorated by the Union Jack; from KENNETH HILL & COMPANY, St. Stephen's House, Victoria Embankment, London, S.W.1, a daily tear-off wall calendar; from H. HENDRA & SON, Townmead Ironfoundry, Beddington Lane, Croydon, Surrey, a monthly tear-off wall calendar surmounted by an illustration of a pretty girl in a green beret; from WRIGHT & COMPANY, of Clarence Street, Sydney, New South Wales, a monthly tear-off wall calendar carrying a design of a ladleful of liquid metal in the process of being cast; from SMITH & FAWCETT, Horton Works, Lidget Green, Bradford, a monthly tear-off wall calendar, each page carrying a different view of the foundry or its productions;

(*Continued in previous column.*)

# The Light Castings Industry

## (From a Correspondent)

MR. J. M. PRIMROSE, writing in the corresponding issue a year ago, was optimistic of the future of the light castings industry for the year to follow. He indicated that the industry gave many indications that the eagerly expected and long-awaited boom period was in the offing. That 1936 has been a year of prosperity and fulfilled hope in the industry is undoubted. Improved production methods have assisted in bringing about a tonnage output in excess of any figure ever reached before, and it is claimed that even during the busy war years the foundry output did not reach the high totals which have been attained this year. At the same time more men were engaged in all branches of the industry than ever before, with the result that the prosperity in the iron-founding trade has stimulated increased business all over the country.

One of the most gratifying features of the increased trade at the foundries is that it has not been experienced only in one department or another; each section of the industry has shared in the new prosperity. During 1935 the iron-founders began to reap the benefits of their far-sighted policy. During 1936 they continued to do so. The majority of the foundries in Scotland are principally engaged in the production of small general and engineering castings; rain-water goods, soil pipes and gutters; baths, stoves and grates; gas and electric cookers and heaters; and numerous light castings for use in the building and allied trades.

Considerable attention was given during the year to the B.I.A. "Melt-on Ear," for fixing pipes to walls. The demand for this improved type of ear, which was first introduced in 1935, has steadily increased, and iron-founders are now looking forward to the time when it will become the standard fitting, and the old-fashioned flat ear, which has served a similar purpose for so many years, will be relegated to that vast museum of patterns found in every foundry—the pattern store. Many of the foundries in the Falkirk district have installed special plant for the manufacture of the improved ear.

In 1935 it was reported that more baths had been produced in Scotland than in any previous year. Comparative figures are not available at the time of writing, but it is generally agreed that the past year's output will surpass that of 1935. An unfortunate point, however, is that prices for baths have not been quite satisfactory, the cheaper type of baths having been sold at uneconomic prices. It is hoped that the ensuing year will bring forth a better range of prices. On the other hand, there is an ever-increasing demand for the better-class bathroom suites, which is expected to result in the ironfounders regaining their losses in the cheaper types of baths.

Mr. Primrose's forecast of the progress in the fitted goods section of the industry has been amply justified. All departments have shown improvements and many foundries report that during the year they have been working to capacity. Fuel economy has become the watchword of the manufacturers of cookers and heaters, and here again striking progress has been made in the designing of grates which combine the advantages of low fuel consumption with efficient heating qualities. This has been done to meet the competition of manufacturers of similar goods in other materials, while the fight to maintain prices has been no light task.

In almost all districts extensions are being carried out at the foundries. This applies to a large extent to the sections which handle gas heating and cooking appliances. The progressive spirit shown by manufacturers of gas appliances in 1935 has been maintained in 1936. Competition in this branch has always been severe, but the trade has still a very bright future before it, with little sign yet of over-production.

# The Non-Ferrous Foundry Industry

## By L. SINGLEHURST WARD, B.Sc.

IN the various reviews of the foundry industry in 1935 an optimistic view was held as to the future. The view has been continued throughout the past year and has been justified by the trend of events. A few years past the state of the industry was such that the economic development of the foundry was nourished by the semi-starvation of the research and technical side. To-day, with easier finance, a fair share of the money apportioned to development is being spent on the building and equipment of new research departments and experimental plant, with the resultant increase in technical staff.

This is a worthy attempt to mitigate the adverse effect of the lean years, for, with the increasing competition in other fields, the safety of the non-ferrous industry depends on a strong and efficient intelligence department.

### Melting and Casting

The practice of melting and casting is being studied with the seriousness one would have expected some years ago, and founders are beginning to break away from old traditions. This has intensified the war waged amongst the exponents of the different methods of melting, and numerous articles have appeared in the technical press. Interest seems to be centred in the relative merits of gas, oil and electric melting, and with the reduction in power costs for the last named, this method is making some headway, especially in cases where freedom from contamination of the melt and soundness of casting are of primary importance. This increase in the use of electric melting has caused the research departments of the gas industry to attempt to improve upon the gas-fired appliances, some of which are already very efficient.

The substitution of water-cooled copper and copper lined moulds in place of solid cast-iron moulds is becoming extended for the casting of copper and copper alloys and trials with aluminium have been successful. This type of mould is not only being used in unit form, it is being installed on continuous machines of the Walker and Clark types.

Experimental work upon the use of copper stools or bottom plates has led to their employment for the casting of nickel alloys. The type of stool used is of cubic shape, with slight depressions on each face to suit the ingot moulds. These stools are used in conjunction with cast-iron moulds for the casting of ingots up to 10 cwts. This introduction of copper stools has resulted in the production of a greater number of sound ingots and a prolongation in the life of the mould.

Rapid advances in the production of alloy die-castings have taken place in recent years and output has greatly increased, but the tendency still is to produce only parts of small and medium size. Producers are beginning to consider, however, much larger sizes weighing a considerable number of pounds, and machines to produce such types of castings have appeared on the market.

### Research Development

With continued increase in production a number of important industrial firms have considered it to be advisable to develop the technical side of their organisations, and during the past year a number of new research laboratories have been opened. The most important are those of High Duty Alloys, the Northern Aluminium Company and the Mond Nickel Company.

The Northern Aluminium Company at Banbury have transferred the existing laboratory equipment to the new buildings. In addition there will be installed further machines for tensile, impact and fatigue testing, an X-ray unit and metallographic equipment. A special research department has been designed and will be equipped with automatic temperature controlled remelting, annealing and heat-treatment furnaces.

High Duty Alloys at Slough have installed an experimental foundry and heat-treatment room besides the normal metallographic and X-ray departments one would expect to see attached to a works of such importance to the aeronautical industry.

The Mond Nickel Company have erected their new laboratories—situated in Wiggin Street, Birmingham—to replace the previous accommodation, which had become inadequate to meet modern requirements for improved alloys and the necessary data concerning them. The equipment is comprehensive and without bias. Facilities are provided for melting, heat-treatment, mechanical testing, micro- and macro-examination on the metallurgical side. A furnace pit containing a 40-lb. gas-fired furnace, and an 18-lb. high-frequency electric furnace, complete with casting pit, have been installed and provision made for further furnaces when required. For heat-treatment and thermal analysis electric and gas-fired furnaces of various sizes have been installed. Other equipment in this section consists of potentiometers, thermo-couple calibrating furnace, and a gradient furnace. In the mechanical testing laboratory are tensile machines of 50 ton, 5 ton and 1 ton capacity; six creep testing units and various fatigue testing and hardness testing machines. The metallography room contains a photo-micrographic outfit and hand microscopes; also housed in this room is a Hilger spectrograph and a Leitz Universal dilatometer for convenience in working. It will be remembered that a full description of these laboratories was printed in the October 22 issue of the JOURNAL.

The various research organisations continue to report good progress on investigations intimately concerned with the non-ferrous industry. At the Metallurgical Department of the National Physical Laboratory continued research on the "light alloys" has been in progress. A section

(*Concluded on page* 72.)

# The Czecho-Slovakian Foundry Industry

By Prof. Dr.-Mont. Fr. PISEK (President, Czecho-Slovakian Foundrymen's Association)

DURING the past year an important increase in activity permeated the whole of the foundry industry, rising to a maximum during the second six months. This increase was due to the economic improvement in both the home and export trade, large complicated special castings being an important contributory factor in the latter case. In addition to orders placed for armaments under the national defence scheme, the home market was benefited by increased activity in the building trades. This was due in no small measure to the operation of the law which grants subsidies for the repair of old houses.

There has been a distinct increase in the buying capacity of the agricultural areas, consequent upon the introduction of the farm products monopoly act. The reaction of this has been a considerable reduction in unemployment amongst the industrial workers; and this, coupled with the increase in wages, has reflected upon the general prosperity of the country.

### Grey-Iron Castings

The output of consumable castings has increased on the average by 20 per cent., as against 1935. The foundries manufacturing these castings are not yet working to full capacity, as exports are hindered by high protective tariffs, but in spite of this there has been considerable improvement amongst those foundries which have had the foresight to modernise their plant and improve their selling organisations. It is interesting to report this revival of exports, as since the severe economic crisis, the export business in castings had almost ceased.

### Engineering Castings

The foundries manufacturing castings for engineering works have been working at 100 per cent. capacity. Some firms have even exceeded the maximum outputs associated with the boom year of 1929. The prolonged crisis, which had its repercussions on the foundry industry, forced the managements to search for new products and

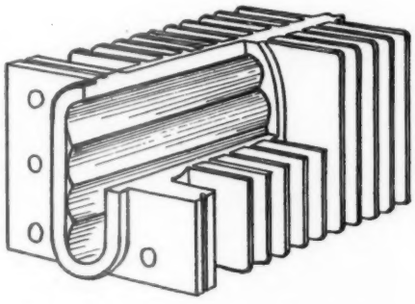

FIG. 1.—NEW TYPE OF ECONOMISER DEVELOPED BY THE VITKOVICE CONCERN.

to increase the quality of their standard lines. Among the innovations, which resulted from these efforts, was a well-designed cast-iron stove. The Vitkovice concern last year developed and placed on the market a special design of economiser, carrying winged ribs of the type shown in Fig. 1. They are made of a special cast iron, are light and are arranged for automatic cleaning. Splendid progress has been made during the year by the foundry of Báňská a hutní společnost at Třinec, which manufactures many types of rolls such as chilled, half-hard, grain, sheet and grooved rolls; chilled rolls are their speciality and are especially esteemed for the rolling of thin hot-rolled sheets. This concern possesses its own large rolling-mill department and close collaboration is maintained between this and the foundry. As a result of experiments which have been proceeding for the last

PROF. DR.-MONT. FR. PISEK.

decade, a grade of chilled roll has been developed which has given the highest degree of satisfaction in surface hardness and real durability. Even so recently as 1935, the average life of rolls in the thin-sheet mills of Karlova Huť, the largest and best-equipped rolling mill in Czecho-Slovakia, was 111 working days of 24 hrs. each. Last year the records up to November 15 showed that for 39 rolls, there was a recorded working life of 137 days. The body length of these rolls varies from 1,100 to 3,100 mm., and the diameter is 700 mm. The result of this systematic collaboration of the foundry with the rolling mill is shown in Fig. 2, which illustrates the increase in the life of rolls since 1931. Another recently developed speciality of this foundry is the manufacture of grooved rolls. The grooves are chill cast, and the rolls are giving every satisfaction, proving superior to the half-hard type; they are being applied to the rolling of angle irons, sheet bars and the like. Fig. 3 shows one of these rolls, weighing 10 tons, mounted on a roll lathe.

### Production Costs

Production costs in the iron foundries are almost the same as those of last year, when related to the individual casting. In some cases, however, an increase was registered owing to the high cost of cast-iron scrap.

On account of the better utilisation of modern foundry plant and increased output on the part of the moulder, foundries making consumable castings have no longer been concerned about the shortage of orders and have been able to lower production costs. There is one instance where the works' costs have been reduced by about 7 per cent.

The prices of raw materials, except in the case of cast-iron scrap, have, in general, been on the same level as in the previous year. Foundry pig-iron No. 1 costs 60 Kc.* per 100 kg. and the No. 3 brand is 58 Kc. The increase in the cost of cast-iron scrap was due to a distinct shortage coupled with an increased demand. It rose from 32 Kc. to 60 Kc. during the last year. Thus it has overtaken the price of foundry pig-iron, and there is still a tendency for it to rise. In order to overcome this difficulty, many foundrymen are using No. 3 pig-iron instead of cast-iron scrap. The price of foundry coke remained unchanged at 33 Kc. per 100 kg.

### Selling Prices and Wages

There has been no change in the rate of wages paid, in spite of the devaluation of the Czecho-Slovakian crown; only one rise has been given, which increased wages by 2 or 3 per cent., as against the level of 1935. With increasing employment, however, some adjustment in salaries is confidently expected in the near future. With few exceptions, the selling prices of castings did not show much alteration during 1936, and at the moment they cannot be considered as being adequate in the light of production costs. During the year several conferences took place with the object of instituting an economic sale price, but, unfortunately, they were all abortive. However, in some districts, a few local agreements have been arrived at.

### Severe Competition Extent

Competition amongst the Czecho-Slovakian foundries making consumable castings is still severe, although, at the present level of production, it is definitely useless. It is obvious that some reasonable selling price agreement should be concluded in order to recover the ground lost during the economic crisis. There are still in existence several foundries which are closed down, and any attempt to secure an economic selling price for the industry is thwarted by a threat to reopen these concerns.

The employment position for the iron foundry

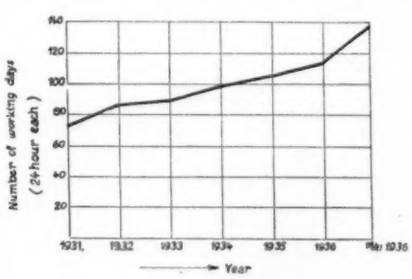


FIG. 2.—AVERAGE LIFE OF ROLLS ROLLING SHEET AT KARLOVA HUŤ EXPRESSED AS WORKING DAYS.

industry for the coming year is distinctly favourable. The building trades are prosperous, whilst money for investment is plentiful. This is bound to stimulate the purchasing power of the majority of the population.

### Malleable Foundries

This section of the industry was fully employed during the year. No less than 40 per cent. more workmen were employed, and the level reached has topped the peak year of 1929. It is in-

* 146 Kc. = £1.

teresting to note that, in spite of this record production, the individual output per man is only about half of that registered in 1929. So far as the raw material prices and wages are concerned, the position is analogous to that reported for the grey-iron industry.

In spite of an increase of 5 to 10 per cent. in the selling price of malleable castings, severe competition is still very much in evidence, and there is no real relationship to the actual costs of production. Efforts to come to some agreement have been abortive.

FIG. 3.—NEW TYPE OF ROLL MOUNTED ON A LATHE.

### Steel Castings

There has also been a considerable increase in the activity of the steel castings section of the foundry industry. The output of the foundries making the small variety of steel castings has been increased by about 30 per cent. The foundries making large complicated castings to a high degree of perfection have also been fully employed, the majority of the orders coming from abroad. Employment in these foundries was higher than in 1929. The Skoda works, in particular, last year produced a vast quantity of large complicated castings, some of which represent real masterpieces of the foundry craft. For instance, the rudder frame shown in Fig. 4 weighs 18,800 kg. and measures 6,220 mm. by 4,900 mm. Another casting, which required very high-grade workmanship, is shown in Fig. 5. It is of toothed cylinders for use in the sugar-cane mills, and is 875 mm. dia., 2,000 mm. long and weighs 6,380 kg. Amongst the large steel castings produced this year at the Skoda works is a locomotive frame, measuring 4,580 mm. by 2,830 mm., the wall thicknesses varying from 14 to 20 mm. This casting is shown in Fig. 6.

In Fig. 7 is shown a series of frames, 4 metres long and 15 mm. thick, delivered for the electrification of the Czecho-Slovakian State railways.

In the field of alloy steel castings, heavy production figures have also been registered, mainly on manganese steel of the 12 to 14 per cent. Mn variety. Amongst these are some steel plates for ore mills, having a diameter of 2,730 mm. and a finished weight of 4,265 kg. (shown in Fig. 8) and a crushing cone having a diameter of 1,610 mm. and 1,530 mm. long, its greatest thickness being 110 mm. and its weight 5 tons (Fig. 9). Another interesting casting made by the Skoda works last year was a large rope drum, cast in two parts. The diameter was 2,275 mm.; length, 960 mm.; wall thickness, 60 to 70 mm.; and weight, 9,600 kg. This casting is shown in Fig. 10.

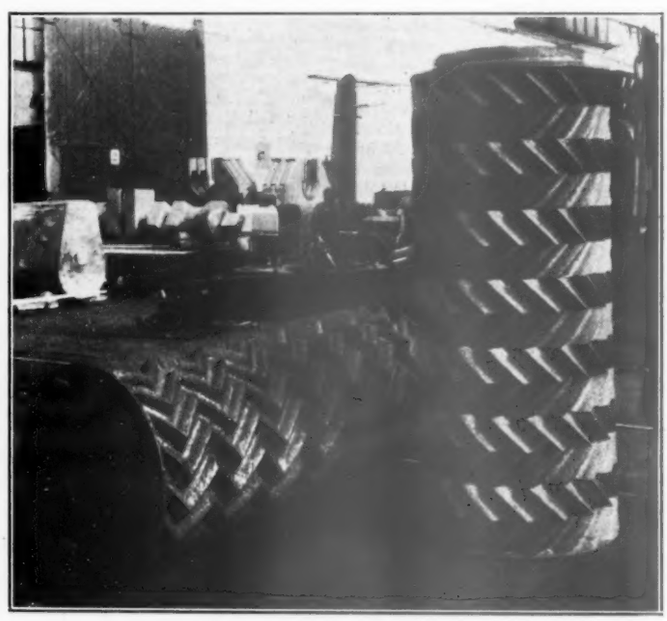

FIG. 5.—TOOTHED CYLINDER CASTING MADE BY SKODA.

For the manufacture of thin-walled castings for the motor-vehicle industry, the Skoda works rely to a large extent upon the electric furnace. The most popular Czecho-Slovakian car is the "Skoda-Popular," which has aroused considerable interest abroad, especially at the Paris Motor Show. It incorporates many steel castings, and these are shown in Fig. 11. In their endeavours to make the highest quality materials, the large Czecho-Slovakian firms are rapidly going over to special steels; for instance, the Skoda works last year built a large number of turbines for use with super-heated steam and high pressures from molybdenum steel.

A popular high-duty heat-resisting alloy is the 28 per cent. chrome material known as "Skoda-Ferchromit." It is largely used for the manufacture of retorts and furnace parts which are

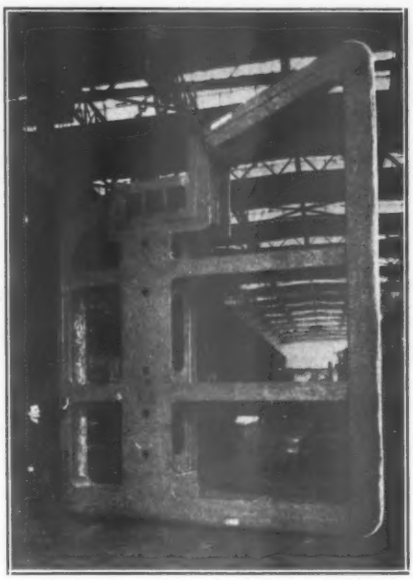

FIG. 4.—RUDDER FRAME CASTING MADE BY THE SKODA COMPANY.

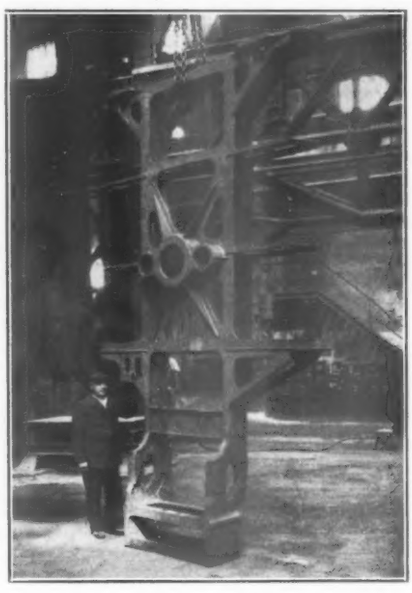

FIG. 6.—LOCOMOTIVE FRAME MADE BY SKODA.

exposed to the corroding influences of heat and high-sulphur-content fumes.

The price of raw materials and the level of wages were much the same as in the grey-iron industry, with the exception that the price of steel scrap increased by about 100 per cent.

The smaller firms are still suffering very badly from excessive competition and no reasonable arrangement has yet been concluded. Selling prices are not yet at an economic level. The prospect for this year, for the production of large complicated castings, is apparently excellent.

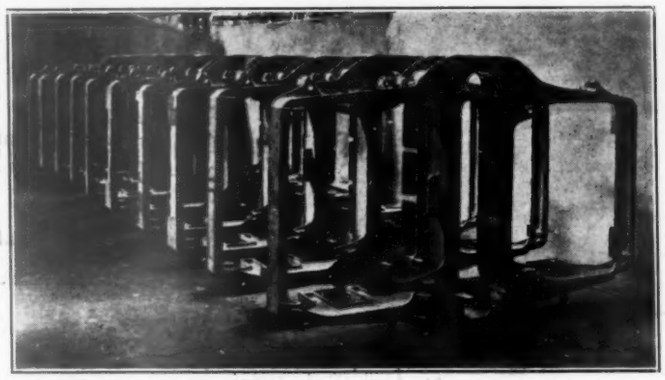

FIG. 7.—CASTINGS USED FOR THE ELECTRIFICATION OF THE CZECH STATE RAILWAYS.

FIG. 8.—STEEL PLATES FOR ORE MILLS.

### Non-Ferrous Foundries

The non-ferrous foundries are spread all over the country, so that it is difficult to obtain a proper basis for discussion. In general, it can be said that a distinct improvement has been registered. Employment in these foundries depends, in a large degree, upon their type of manufacture. In some cases production has been increased to the level of 1929 and has even exceeded the record then established. In other cases employment has increased but little.

FIG. 9.—CRUSHING CONE CASTING BY SKODA.

FIG. 10.—LARGE ROPE DRUM MADE IN TWO PARTS BY SKODA.

### The Polak Die-Casting Machine

In the field of die casting, four foundries are now using die-casting machines of the type developed by Mr. Polak. It is no exaggeration to say that his design of die-casting machine is to-day the premier model in the world. The latest model of this type was shown in operation at the Düsseldorf Foundry Exhibition last September—the machine forming one of the outstanding exhibits of the show.

Mr. Polak has undertaken the task of making a simple die-casting machine for operation on brass and bronze, as well as for aluminium alloys. The moulds used are both cheap and rapidly constructed. Castings of aluminium and some brass alloys containing, of course, a minimum of 5 to 10 per cent. Al, can be comparatively easily made in die-casting machines. It is not easily possible, however, to manufacture brass and bronze die castings from metal in the liquid state, as the casting temperature of brass is about 1,000 deg. C. and considerably exceeds the critical points of highly-alloyed tool-steel moulds. Thus, these costly moulds, which should last for at least 10 to 15 thousand castings, are useless after a few hundred operations. This problem has been solved by Mr. Polak, who showed that copper alloys having a wide solidification range (brass containing 57 to 61 per cent. copper, some kinds of bronze and most of the light alloys), when transferred by ladles during the solidification range to the machine, gave castings of the shape communicated to them by the mould.

The principle in this operation is that the metal is taken up in the pasty state by means of a ladle, and a definite amount of pasty metal is transferred to a container, arranged along the parting line of the die, and then the metal is forced into the cavity by means of a piston, as is shown in Fig. 12. Thus, the high casting temperature of brass is negatived and the moulds last longer. The construction of a mould for making a water tap is shown in Fig. 13. It is made from heavily alloyed steel. Cores are also made of steel, and are set into a pivot and connected with the hydraulic core levers on the machine. The latest construction of Polak's die casting machine is shown in Fig. 14. It consists of a hydraulic press carrying two cylinders and two pistons, one of which serves for the casting and the other for ejecting the finished casting. The hydraulic support of the moulds is placed on side guide-bars, by means of adjusting stays, so as to avoid its wearing off. In situations where the finished castings are ejected, there is a hollow upright which allows the automatically ejected castings to fall on an inclined plane, situated beneath the machine. The castings may be ejected from either side of a movable or fixed die, enabling core extraction to take place in five principal directions, i.e., through the two half-dies, or in three main direc-

tions along the parting line. All these movements are made hydraulically with a 5-in. hand lever. The mould is held by six screws and may be changed, according to the number of cores, every 10 or 20 minutes. Varying with the type of casting, skilled workmen will carry out 3 to 12 operations a minute. In an eight-hour shift, the production can reach a level of 1 to 2 thousand castings, including the addition of fresh metal to the furnace, its deoxidation, heating-up period, the cleaning of the dies, and so on. The machine is actuated by means of a combined pneumatic hydraulic accumulator, driven by a 6 to 20 h.p. motor, according to the size of the machine. This machine grouping itself into the split gate system, is used for brass castings having weights ranging from a half to over two lbs. For larger castings, high-pressure hydraulic die-casting machines of the centred gate system are being constructed. By means of these machines, it is possible to produce brass castings up to 50 lbs. weight and aluminium castings of the order of 20 lbs.

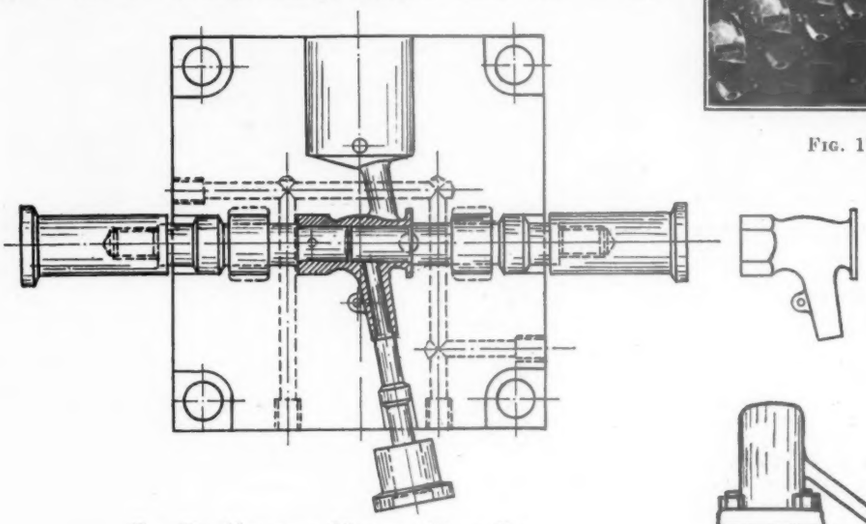

FIG. 13.—MOULD FOR MAKING A WATER TAP.

At the Düsseldorf Foundry Exhibition, the machine carried a squirrel-cage rotor, the windings of which were made from iron sheets. This machine was filled with pure aluminium, which formed ventilators on both sides. The weight of this rotor was 160 lbs., whilst the weight of the aluminium parts amounted to 20 lbs.

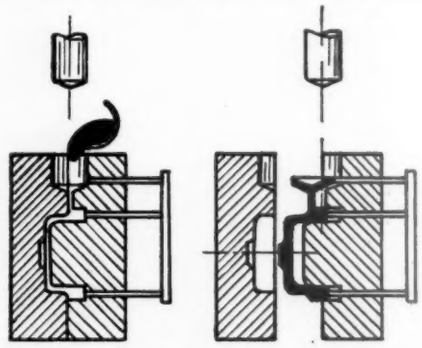

FIG. 12.—METHOD OF INTRODUCING THE METAL INTO POLAK MACHINES.

## Commercial Considerations

The recent devaluation in Czech currency produced an increase in the price of the raw materials used by the non-ferrous foundry industry. Wages have remained stationary and competition between the smaller foundries is still keen and rather harmful to the securing of an economic sale price.

## Raw Materials

The improvement registered in the foundry industry has also had a profound influence on the trades which supplied them with raw materials. For instance, in the pig-iron industry, the large stocks which have been accumulated during the years of depression have been sold out during the year, and the production of foundry pig-iron was double that of 1935. This is shown by the production of the two largest works producing foundry pig-iron:—

*Vitkovice.*—1935 production, 38,000 tons of foundry pig-iron; 1936 production, (estimated) 60,000 tons.

*Báňská of Třinec.*—1935 production, 4,404 tons of foundry pig-iron; 1936 production (nine months), 8,421 tons.

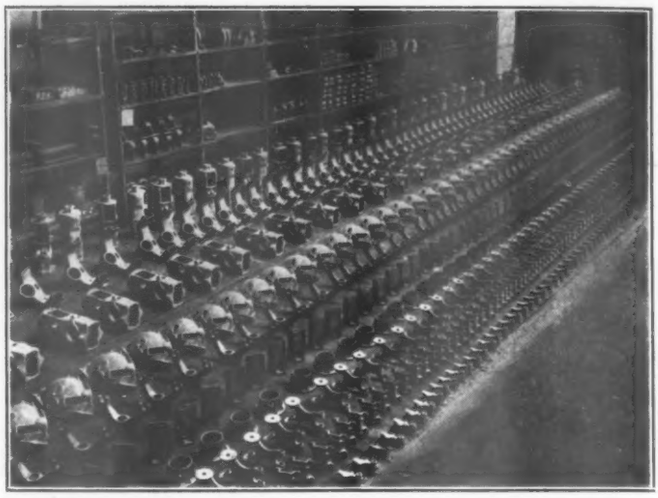

FIG. 11.—STEEL CASTINGS FOR MOTOR VEHICLES.

The amount for foundry coke used also increased, and the coke ovens relighted batteries of furnaces that had been out of commission for several years. The increased consumption of foundry coke is best seen from the quantities sold in the Moravskà Ostrava region, the only district in Czecho-Slovakia producing foundry coke.

1936.—1st quarter, 18,269 tons; 2nd quarter, 22,653 tons; 3rd quarter, 25,577 tons; 4th quarter will probably be about 30,500 tons.

Last year the consumption of foundry coke was of the order of 96,000 tons, as against 86,000 tons in the previous year.

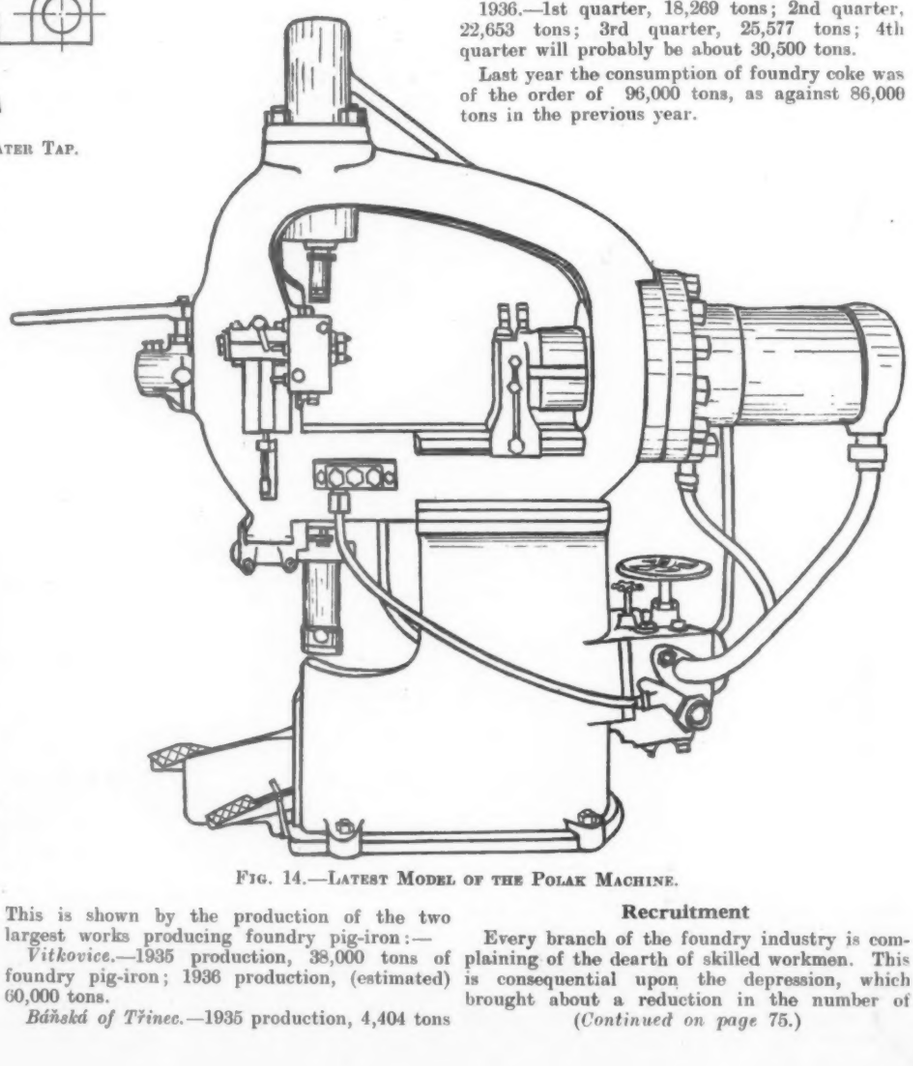

FIG. 14.—LATEST MODEL OF THE POLAK MACHINE.

## Recruitment

Every branch of the foundry industry is complaining of the dearth of skilled workmen. This is consequential upon the depression, which brought about a reduction in the number of

(*Continued on page* 75.)

# The Foundry Industry in Scandinavia

## By Civilengenjär SIXTEN NILSSON

IN the Annual Review Number of the journal last year the author had the pleasure of relating the situation existing within the foundry industry in Sweden, and this year the Editor has asked him to extend the report to cover the position in the other Scandinavian countries, Norway and Denmark.

As the three countries are very closely related and extensive communications between their foundrymen are going on, the situation within the foundry industry is similar in the three countries. In some respects, however, differences may be found.

### SWEDEN

The good situation in the Swedish foundry industry, detailed in the last report, has developed into a state that must be called prosperity. In Denmark and Norway this development has come a little slower and has not been so marked as in Sweden.

The Swedish ironworks, the mine, lumber, paper, wood pulp, cellulose and machinery industries have been working at full capacity and this activity is reflected in the foundry industry. The building trade has been unusually active, both as regards the public authorities and private enterprise. The government has been endeavouring to improve the standard of housing, especially for industrial and agricultural workers, and this has given the foundries making cooking and heating stoves, central-heating apparatus and sanitary ware a really busy time.

Shipyards have been working to full capacity, and consequently their foundries also have been fully engaged. The electrification of the State railways has been a link in the chain of the Government's action against unemployment and has brought business to the foundries. All this has diminished unemployment to such an extent that Government activities towards its reduction are being cancelled.

The increased activity of the foundries has been followed in many places by a modernisation of their shops and working methods. Nevertheless, so-called "straight line" production or complete mechanisation has rarely found its way into the foundries, the products not being of a sufficiently uniform size.

As to the quality of the products, there is a noticeable trend towards the preference for high-duty or alloyed grey iron castings instead of steel castings, this being possible on account of the widespread use of charcoal pig-iron in addition to improved working methods.

The development on the pig-iron market has shown increasing prices of domestic as well as foreign brands. The price of the Swedish charcoal iron will increase considerably, due to the scarcity of charcoal, accentuated by the demands for wood from the wood pulp industry. Charcoal pig-iron suitable for export is sold in Sweden at 120-125 crowns per ton, special brands for chilled castings being still higher.

The domestic manufacture of ordinary coke-smelted foundry pig-iron is still limited to one furnace, the demand being mainly covered by imports from Germany, Holland and France; some shipments were received from Russia and India for absorption by the Swedish market.

The quality of coke is still the same as described in the author's last report, whereas the price has risen lately. Westphalian coke is mainly used and was being sold for about 32 Swedish crowns per ton c.i.f. Stockholm during the autumn.

The research work in the Swedish foundry industry is as yet not officially organised, but is at the present time under close consideration.

### NORWAY

The Norwegian foundry industry mainly consists of stove foundries and foundries serving the shipyards. The first group is the larger and produces, in addition to the ordinary castings to be associated with such foundries, castings for electrical appliances, which are widely in use in the country due to the existence of cheap electric energy. On account of the substitution of the old-type heating stoves by radiators heated by steam the production of the former is decreasing. Due to an active re-housing programme these foundries have had an abnormally prosperous year in spite of keen foreign competition, particularly in the field of household goods,

ENG. S. O. NILSSON.

sanitary ware and boilers. During the past year two enamelling works have been erected.

Castings for shipbuilding are produced partly by the shipyard foundries themselves and partly by jobbing foundries. The shipbuilding industry in Norway is rather limited when the extent of its great merchant fleet is considered, but the foundries have specialised in manufacturing spare parts for the Diesel engines and have achieved very good results in this direction, due to the use of electric melting furnaces and vanadium pig-iron of a high quality, produced in the country. In general this year has been better than previous years for these foundries.

The Norwegian steel foundries are few and small, with the exception of one which has specialised in castings for the shipbuilding industry. They all use electric furnaces and have been fully employed this year.

Malleable castings are not produced in Norway.

Only a few years ago, pig-iron of the Cleveland type was predominant for the Norwegian stove plate production and for machinery castings additions of English hematite, English C.-B. iron and Swedish charcoal iron were made. During the past year, however, the English iron has been substituted for other brands of similar types, such as Dutch, Belgian Halaney, German Hansa, Swedish Oxelösund, the question of price being the deciding factor. A great deal of Middlesbrough iron is still used, although its price has been slightly higher. Lately Russian iron has been offered and bought in considerable quantities at a price up to 10 Norwegian crowns per ton lower than that of any other brand. It has proved to be satisfactory, but at present there seem to be difficulties in delivery, and at the same time the price has risen.

For quality machinery castings, the Norwegian pig-iron, produced in electric melting furnaces, has found a steady market. The following types are produced:—(1) Hematite, substituting foreign brands; (2) cold-blast, with 2.3 per cent. C used instead of English material and Swedish charcoal; (3) Vantit iron, carrying 0.7 per cent. Va, about 0.4 per cent. Ti and about 4.0 per cent. C (also available with 2.8 to 3 per cent. C). This iron now generally constitutes the bulk of the mixtures intended for high-duty machinery castings, and it is also exported.

The larger portion of the production in Norway of ferro-alloys and alloying briquettes is generally exported, and little is used in Norwegian foundries.

The prices for the various brands of pig-iron c.i.f. Oslo as per last summer are as follow:—

| | | | |
|---|---|---|---|
| Vantit ... ... | Norw. cr. | 120 | per ton. |
| Norwegian C.B. ... | ,, | 110 | ,, |
| Norwegian hematite | ,, | 80 | ,, |
| No. 3 Middlesbrough | ,, | 75 | ,, |
| Russian ... ... | ,, | 60 | ,, |

The prices have risen during the autumn. It has been, as usual, difficult to get good foundry coke, and the price has risen to over 40 crowns.

### DENMARK

Denmark, being forced to import all the raw materials for the iron industry, is the worst situated country, from the industrial aspect, in the Scandinavian group. This fact may account for its industry not showing the same increase as that of Sweden and Norway. Another important reason is the difficult price restrictions placed upon the industrialist. From a retrospective survey over the last two years 1936 will show approximately the same output as 1935, in spite of a six-week lockout.

The foundries in Denmark may be classified into four groups:—(1) Foundries for making stoves, ranges, boilers and radiators; (2) foundries working for the shipyards; (3) foundries making agricultural implements; and (4) jobbing foundries.

The total output of castings is equally divided amongst these groups. In 1935 the output was 86,000 tons, satisfied by a consumption of about 55,000 tons of pig-iron, of which 38 per cent. came from England, 34 per cent. from Germany, 15 per cent. from Holland and 13 per cent. from Sweden. During the past year some Norwegian Vantit iron has been imported. The pig-iron prices are the same as in Sweden and Norway. No. 3 Middlesbrough is now being sold at over 90 Danish crowns c.i.f. Danish ports.

During this year the shipyards in Denmark have been rather heavily employed, the orders coming mostly from foreign countries, especially Norway. The biggest foundry in Denmark belongs to this group, and considering its equipment it is equally well placed with foreign foundries entering this group.

The building trades have been very active, due mostly to private enterprise, and the foundries making stoves, ranges, etc., have been exceptionally busy. The Danish stove foundries are extremely progressive. They have taken artists into their service to produce beautiful and at the same time cheap stoves for embellishment of their homes, even for those destined for the workmen.

*(Continued on page 75.)*

# Recent Progress in the Belgian Foundry Industry

## By GUSTAVE MASSON (Consulting Engineer; Past-President, Belgian Foundrymen's Association)

FROM the economic aspect, the position of the Belgian foundry industry has considerably improved during the year and this is a matter of distinct satisfaction. The heavy industries have experienced a period of real prosperity, and the whole of the various trades dependent upon them have benefited thereby to varying degrees. The foundries were not the last to profit from the situation; order-books are well filled, unemployment has been heavily reduced, and prices have a distinct tendency to rise—the margin of profit is often substantial.

It is interesting to take note that this rebirth of prosperity in Belgium has taken place although the international situation is definitely unstable and distinctly disturbing. Unquestionably the demand is real after a prolonged crisis, and it is believed that in spite of the complications in the international sphere this prosperity will continue and during this period industrialists are bound to gain some real compensation for the critical time they have undergone.

The writer is unable to give figures concerning the activity of the foundry industry during the past year, and consequently to qualify his statements, but this improvement is incontestable and will gather impetus.

### Technical Developments

It is pleasing to be able to state that fresh progress has been made by a number of foundries. Many installations of well-designed melting furnaces have been made and existing plant has been modernised. An increasing resort is being made to special alloyed pig-iron associated with intensive research into the production of better grades of metal. This latter is sometimes accomplished by the churning system devised by Prof. Girardet, by the soda-ash process or by other means. The results obtained in the manufacture of high-duty alloyed irons, for acid-resisting purposes, or for withstanding elevated temperatures and the like, are also of

MR. G. MASSON.

prime importance. This effort towards the production of better material is permeating the entire foundry industry, including the grey and white iron, malleable, steel and non-ferrous sections. Especially has excellent progress been made in the malleable section in the manufacture of articles hitherto the perquisite of foreign enterprise.

### Technical Association

Last year the Association Technique de Fonderie de Belge celebrated the twenty-fifth anniversary of its foundation. It is rather a pity that this event was limited to a scientific session. The President, Mr. Léonard, recalled in a noteworthy address the modest beginnings of this association, the hard work and tenacious spirit of its founders, and the unfailing efforts of its leaders. He thanked all who had contributed to the prosperity of the society. He profited by his recent visit to Düsseldorf and Berlin to relate his impressions of the recent international congress, and indicated the various improvements in technique that he had noted.

This address was followed by a masterly thesis on the metallurgical evolution of the foundry by Prof. Portevin, of Paris. The lecturer, with the usual fluent style for which he is justly renowned, dealt with his subject with his innate clearness and logic.

The following is a synopsis of the Professor's lecture. He dealt with the improvement of castings from two angles: (*a*) the metallurgical problem or metallography—that is to say, the improvement and adaptation of the inherent properties of the metal, and (*b*) the foundry problem, which in this case is the production of a sound casting which is an exact replica of the pattern or design. The value of metal and the casting depends successively upon the following factors and operations:—

(1) Composition of the alloy and the coke bed.
(2) Melting and mixing conditions.
(3) Pouring and solidification conditions.
(4) Thermal treatment.
(5) Control of operations and products.

The audience followed the speaker with absorbing interest as he took them through the various phases of his subject, and the success of the lecture was unquestionably very great. Thus ended this all too short jubilee celebration, which will long remain a happy memory, thanks to Prof. Portevin and his noteworthy lecture.

## The Non-Ferrous Foundry Industry

(*Concluded from page* 66.)

of one research—solubility of gases in aluminium—has been brought to a successful conclusion. This section concerned the extent to which aluminium can dissolve hydrogen; the results obtained were in agreement with those obtained by other investigators in Germany. Investigation is now in progress on the effect of other gases, soluble in aluminium, on the casting properties of this metal and certain of its alloys. In other divisions of light alloys research attention is being given to certain of the magnesium alloys—magnesium-silver, magnesium-cerium and calcium series.

The British Non-Ferrous Metals Research Association, which has also been conducting investigations upon the effect of occluded gases in alloys, have evolved a process for the degassing of aluminium and aluminium alloys. This has been patented. Other researches in progress include the effect of cast structure on the working properties of zinc and magnesium, minimising the effect of certain impurities in various metals and alloys, and further work on controlled grain size.

During the past year numerous new or modified specifications of interest to the non-ferrous industry have been published. The following are of particular interest:—B.S.S. 702 (silicon aluminium alloy castings), B.S.S. 703 (Y alloy castings, cast), B.S.S. 704 (Y alloy castings, heat-treated), D.T.D. 287, 298, 304, 309, 313 (aluminium alloy, sand or die castings), D.T.D. 297, 289 (magnesium-aluminium).

It is interesting to note that the Non-Ferrous Sub-Committee of the Institute of British Foundrymen is trying to simplify the numerous specifications—official and otherwise—for gunmetals and have made useful recommendations which are being intelligently discussed by both manufacturers and users.

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INTERNATIONAL COMBUSTION, LIMITED, has received two boiler orders recently. These comprise four Lopulco pulverised-fuel-fired boilers to be installed at the Karabuk Iron and Steel Works, Turkey, and three stoker-fired boilers for Ford Paper Mills, Limited. The boilers for Turkey will have a normal evaporation of 50,000 lbs. per hr. and a maximum of 65,000 lbs. per hr.; working pressure 375 lbs. per sq. in. and steam temperature 725 deg. The order also covers boiler-house piping, coal- and ash-handling plant, Usco plate-type air-heater and water-softening plant. An order has also been received from Wiggins, Teape & Company, Limited, for an Usco air-heater and duct work for their Buckland Mills, Dover. This will comprise 70 elements 9 ft. long, exposing a total heating surface of 5,670 sq. ft.

## Book Review

**Shrinkage,** by H. A. SCHWARTZ. Published by the Penton Publishing Company, Caxton House, Westminster, Price 5s. net.

We know of no other publication which better typifies the profound change which has dominated American foundry research work in recent years more than the book under review. Until a decade ago we are afraid that "night-school research" was the criticism generally levelled against it. Now Mr. Schwartz has found the Greek alphabet is necessary to express the result of his investigations. The work undertaken has been of a fundamental character, and has a direct relationship to the practical determination of feeding castings. There are nine chapters and in them some seventeen problems are posed and treated mathematically. Problem 14, for instance, reads "Consider the relative heights and diameters of casting and feeder in order that there may be no draw—i.e., void in the casting below the lower level of the feeder." The solution is given in the form of an equation. This book should be in the hands of every teacher of foundry practice, as a theoretical background to such problems as shrinkage is nowadays a necessity.

V. C. F.

# The French Foundry Industry

## By MAURICE WERTS (President, French Foundry Technical Association)

LIKE all the other French industries, the foundry industry has suffered from the repercussion of profound social changes, sometimes preceded, accompanied or followed by incidents detrimental to the satisfactory conduct of business. It may even be said that at a certain moment, these incidents actually brought about an almost complete stoppage of business transactions.

The commencement of the year was normal if we consider as normal the course of affairs shown by the past ten years. The months of January and February are generally marked by recrudescence of orders after the restrictions which most consumers make for stock-taking purposes at the end of the financial year. In 1936, these two months did in fact witness a relative abundance of interesting orders, but at extremely low prices which even then the customers did not accept without hard bargaining.

### The Election Results

Then came the approach of the electoral campaign, which appeared in an unusual light, fraught with uncertainty—not a very favourable condition for the progress of business; working programmes held in suspense in managerial departments, hesitation on the part of engineers and merchants, all these various factors hampered business and caused it to slacken from the month of March onward. The result of the elections in bringing into power the Popular Front was not likely to alter this state of affairs. It was at once felt that events of a fresh nature were to be expected, and uncertainty is always an element of caution in industrial undertakings. The conditions prevailing since March continued, therefore, until June, at which time, under the pressure of the people, the new Government imposed on industry laws which the same Government had not had the time to study fundamentally, and the application of which could not be delayed. If some wages were too low, it would undoubtedly have been possible to raise them gradually without bringing the industries face to face with hurried necessities, fraught with consequences for the costs of production of orders being negotiated or already accepted.

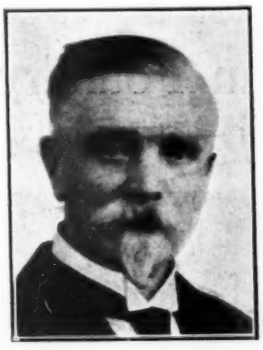
### Holidays with Pay

Even admitting the desirability of granting paid holidays to the working class, the fact that they were wholly compulsory from the first year, and that in consequence of decisions made in the middle of the year they had to be granted within relatively short periods, caused great confusion both in the execution of orders already booked and as regards the possibilities of booking fresh orders. In short, the numerous instances of strikes with the object of securing new social laws, the difficulty of applying these more or less unprecise laws which were more or less difficult to interpret, the more or less open conflicts which followed, all caused business to be brought almost to a standstill for more than two months. At the same time, the production of the works fell off considerably.

### The Forty-Hour Week

The resumption of business after these events was laborious, slow and difficult. The manufacturers had to re-organise their work in agreement with the new laws, not always an easy matter. The obligation to limit the working week to forty hours in place of forty-four or forty-eight is a matter which can easily be faced by an industry that is entirely manual for instance, and only employs labourers. Matters are different, however, in foundries where restrictions are imposed by the capacity of production of the melting plant and machines and by the necessity for skilled labour mostly recruited in a very limited area around the places of production. Such arrangements require time, and yet the employers were hustled and called upon to take certain steps without having time to make up their minds, and to effect others which, up to a certain point, might have weakened the consequences of the first steps.

Matters were made still more complicated by the fact that the forty hours' per week law demanded, for its application, methods varying from one industry to another and from one area to another. The governmental decisions could only be taken with certain delays and the periods were always too short to do the work perfectly. The negotiations between employees and employers, which ought to have facilitated the arrangements, were often hampered by the fact that the workers' delegates, instead of being chosen from the best workmen and those most able to understand the industrial and commercial



MR. MAURICE WERTS.

exigencies, were rather political representatives. Taking as a basis the new wages fixed for the Paris area, it was necessary to apply coefficients for the cost of living in each area considered. These adjustments, however, were very laborious, and, until they were made, the progress of industry was difficult, irregular and of low output.

### Result of Wages Adjustments

These adjustments of the wages to the local living conditions had another consequence—the displacement of certain industries. Foundries which up to that time had only been able to exist owing to payment of very low wages had to make bigger advances than those which their competitors in the same area or in more or less remote areas had to make, and the increase in their costs of production and selling prices diverted their customers to the latter works where the increases in prices were less.

Examined from a point of view which, though not so commercial, might have serious consequences for the foundry industry, the new wage scales have also resulted in a levelling tendency which is not likely to encourage the supervising staff. Thus, in the Paris area a good moulder will earn 2,000 to 2,100 francs a month (£20 to £21), while his foreman will only earn 2,300 to 2,700 francs (£23 to £27), according to the foundry. This is due to the fact that the new scales in the Paris area have been worked out and imposed by engineers and not by moulders. Although such slight differences may be admissible or even justified in engineering, it is not so in the foundry industry, where the foreman has a much greater responsibility and has to possess a considerable technical superiority over his staff, the consequence of exceptional qualities and long experience of his trade. It has been shown earlier in this report that even before the period of the workers' holidays the production of the foundry industry had slowed down appreciably. In addition to this, the holidays, which the manufacturers had not been able to take into account when drawing up their programmes, had to be considered. In most cases it was impossible to complete the orders in the stipulated times, sometimes important orders were cancelled for that reason and placed in neighbouring countries such as Belgium, Switzerland or Luxembourg. This exodus of orders abroad was still further assisted by the successive rises in the prices of pig-iron, which were even greater than the increases due to the new social laws. Thus "Peau lisse No. 3" cast iron rose from 210 fcs. to 375 fcs. a ton (from £2 2s. to £3 15s.).

### A Trade Revival

After the holiday period, however, a revival of business set in. This was, perhaps, due to the consumers being unable to keep back the orders which they had held up in the period of uncertain prices, or, perhaps, they hastened to place their orders in the fear of fresh rises (which, moreover, was in accordance with the wishes of the Government). Be that as it may, from the end of September to the end of November, judging at least from personal experience, business transactions assumed proportions that had not been seen for many years at such a time, despite the new rise in prices of 15 to 20 per cent. resulting from the application of the forty hours law.

There has since been a considerable retrogression, and any business dealt with seems to be limited to the residue of old decisions requiring considerable preparations which, like the production of the foundry industry, had been slowed down by the political and social events.

### The Future

In short, at the end of 1936 the French foundry industry was in a difficult position, which, however, must only be regarded as transitory. It is to be hoped—and may be expected—that there will be an early cessation of the disputes, many of which have already been settled, and the last of which are probably mainly the result of political scheming. The prices of raw materials, which have been considerably increased as the result of commercial agreements, can and ought to be stabilised now. The French foundryman, vigorous and ingenious, will then be in possession of all the elements of the problems devolving on him and will be able to solve them by organisation and installation of equipment.

The best use must be made of all available labour, but this does not exist to an unlimited extent, especially as regards the highly skilled type. In the Ardennes, for instance, there is almost no unemployment in the foundry industry, even among the labourers employed on machine moulding. Skilled workmen are scarce in numerous branches, and there are not sufficient of them to be found for strickle moulding large castings in loam or sand, nor for die-casting of aluminium and aluminium bronzes. There is no doubt that the public authorities and the employers' associations will reproach themselves for failing to organise to the greatest possible extent a system of apprenticeship in the foundry industry; already numbers of practical men have drawn attention to the scarcity of first-class workmen. This problem of apprenticeship will be more difficult to solve at the

present than if it had been tackled earlier. If a workman is to be induced to make some sacrifices in order to become a first-class workman, he must be urged to do this in the expectation of appreciable material advantages. From this point of view, the reduction in the difference between the lowest and highest wages is not an encouragement. Nevertheless, the problem is not one which cannot be solved, and its elimination will depend upon the desire to solve it.

### Plant Development

Improvements in plant may help to a certain extent; but in this connection 1936 has not shown many developments. It is scarcely possible to mention anything but a few changes in cupolas and some fairly appreciable progress in the construction of melting furnaces, particularly rotary furnaces. The new necessities created by the deep-seated changes in industrial life will no doubt urge engineers to seek very soon a remedy for the increased wages and the scarcity of highly skilled labour in the improvement of plant.

### High-Duty Irons

Turning now to foundry methods, it can be noted with satisfaction that even if half of 1936 witnessed an agitation which was not very favourable to progress, the French industry has not been inactive or remained in the old ruts.

In the iron-foundry industry the production of special cast irons has assumed remarkable proportions, and the country possesses good specialists in the production of pearlitic and austenitic irons. The manufacture of "Meehanite" castings has also been introduced. For various reasons manufacturers are obliged to sell it at high prices, and this often results in malleable cast iron being preferred. It is known that foundrymen are at present making serious efforts to lower these selling prices. Some foundries are interested in the manufacture of soft permanent mould castings, but the writer is not aware that any important results have so far been attained. Centrifugally cast pipes are still being manufactured with success, but without any well-marked technical advance over the previous year. Some manufacturers are interested in the pressure die-casting of grey iron, but again the author is unaware of any practical results up to the present. There is nothing specially worthy of mention as regards malleable castings.

### Steel-Foundry Practice

Recently, the steel-foundry industry has witnessed a growth in the use of rotary furnaces with a consequent marked increase in the production of special steels. Oil-fired furnaces appear to enjoy a preference over furnaces fired with pulverised coal, due to their greater flexibility in working and simplicity of the plant. Electric furnaces also have received new applications. In short, France is in a good situation for the production of high grade steels of widely varying composition.

Among the non-ferrous metals, it is necessary to record the considerable progress in the use of lead bronzes, large consumers of which are the railways. The production of aluminium bronzes, especially chill cast, has also greatly increased, as well as that of die-cast brass. There has again been an increase in the use of super-light alloys, particularly Elektron, which is meeting with numerous applications in aeronautical constructions. The technical progress in the manufacture of die-cast aluminium alloys and alloys of low melting point is remarkable. It may be said that in this field the French industry has acquired a more than creditable position. Mention should also be made of the increased use of "Alpax," which has replaced cast iron in certain applications where the reduction in weight and the resulting advantages compensate for the increase in price.

The association over which the author presides sends cordial greetings to its British *confrères*, and hopes to see as many of them as possible in Paris on the occasion of the International Foundry Congress and Exhibition to be held almost immediately after the Institute of British Foundrymen's Conference at Derby.

# The Italian Foundry Industry

## By Dr.-ING. GUIDO VANZETTI

IN 1936 Italian foundries had to face a situation absolutely different from that of previous years, because of the economic blockade decreed by the League of Nations and the imperious necessities imposed by the colonial war.

The considerable difficulties encountered in the importation of raw materials and semi-manufactured or manufactured goods, as well as the obligation to avoid, as far as possible, allowing gold currencies to leave the country, have induced the directors of Italian foundries to seek new methods of production. The necessity for reducing imports to a minimum has often forced manufacturers to adopt methods which, although uneconomical from the general point of view, were advantageous from the point of view of national economy by obviating the export of currency. It is nevertheless beyond doubt that, aided by necessity, self-respect and enthusiasm, the Italian industry has covered in one year much more ground than in the course of several of the preceding years. For this reason there has been a fairly large increase in the productions of steel, iron and various alloys.

A serious attack was made on the problems peculiar to the new situation of a country almost isolated from the rest of the civilised world. Previously, no one had ever even dreamed that such problems would have to be solved. An effective contributory factor in solving these problems has certainly been the spirit of industrial co-operation—formerly rather undeveloped—between the various competing firms who, in exercising this spirit, have preferred the common welfare to their own personal interests. Thus, they have found that most castings can be made quite successfully in Italy by their own means, employing in a large measure raw materials obtained on Italian soil.

### New Raw Material Sources

Since this phenomenon of the emancipation from foreign markets has occurred in all branches of Italian national industries, many new establishments have arisen, particularly in connection with the chemical industries and the distillation of mineral oils.

DR.-ING. GUIDO VANZETTI.

Italian foundries have had much work in these fields, as well as in the field of naval construction, where steel and cast iron possessing special qualities are particularly required. Large orders especially have been placed for castings of rustless steels of various types capable of resisting both chemical corrosion and the action of heat, chromium-molybdenum steels for oil-cracking apparatus, pearlitic cast iron of high mechanical resistance to wear, special bronzes, light alloys, etc. The use of high-duty cast iron has met with considerable success with machine constructors, so much so that six of the most important iron-foundries have acquired licences to manufacture by the Meehanite processes.

It is a well-known fact that considerable quantities of foundry sand, especially for steel-foundries, were formerly purchased abroad. As the result of assiduous geological investigations made in Italy, the deposits of quartziferous sand of Tenda and Torre de Lago, as well as the deposits of argillaceous sands of Vicenza and Bassano del Grappa, have been utilised with excellent results. Synthetic sands agglomerated with Italian bentonite obtained from the recently discovered deposits in the Pontine Islands in the Gulf of Gaeta, have also been utilised with excellent results.

Recently some of the more important Italian foundries have adopted the Randupson process, in which sand and cement are used, for casting large parts.

### Non-Ferrous Alloys

There is nothing particularly new to report as regards the light-alloy foundries. Despite the difficulties, the Italian production of aluminium and consequently also of alumina has greatly increased, and has thus been able to meet the considerable demands of the market.

In order to economise in tin of foreign importation, castings of aluminium bronze have been employed on a large scale, with excellent results, for supplies to the navy and air force.

As regards the production of magnesium, the use of which in the form of Elektron has considerably increased, a company has been formed and will soon be in a position to produce this metal from Italian minerals obtained in Sardinia.

### New Developments in Magnetic Steels

Before completing this brief report on the activities of Italian foundries during the past year, the author would like to mention a new and interesting problem which has been attacked and recently solved. It is a well-known fact that only some of the magnetic steels can be rolled and successively forged, while the others, as well as all nickel-aluminium alloys, have to be cast in the desired shape.

It has now been found that even with forgeable steels, such as chromium, tungsten and cobalt steels, excellent results may be attained from the point of view of magnetic properties, and sometimes even from the economic point of view, by casting these magnets directly in the final form. The problem was one of special importance for Italy in view of the inadequate production of rolled magnetic steel.

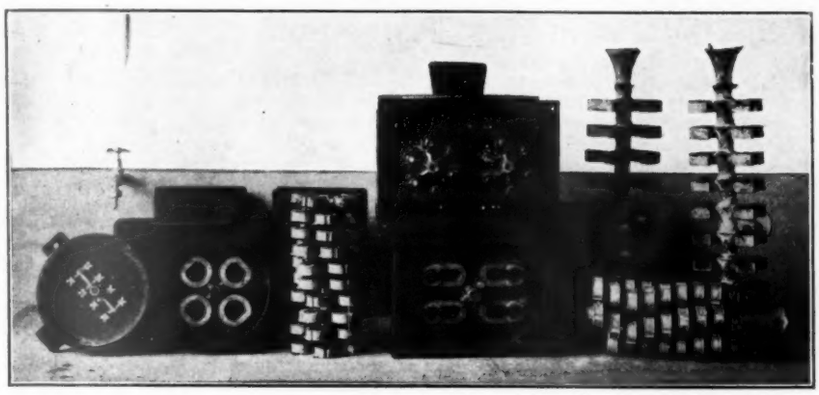


FIG. 1.—METAL CORE-BOXES AND STACKS OF FINISHED MAGNET CASTINGS.

It has been found in the first place that there are no substantial differences between the magnetic characteristics of two identical pieces of the same steel, one of which has been forged and the other cast. Since large series of castings, sometimes weighing only a few grammes, have to be produced with very small dimensional tolerances, the very specially equipped foundry ought to see that casting is carried out with the skill adapted to make the production economical. To prevent wastage of metal, it is not possible to cast the parts one at a time, or even a few parts in the same mould, since the weight of metal in the pouring basin and runner is out of all proportion to the weight of the castings.

### Large Clusters Cast

It is essential to cast magnets in a group or cluster comprised of multiples of tens of parts—generally from 80 to 180—with a single central runner.

The magnet metal is melted in a separate department provided with high-frequency induction furnaces of various capacities, so that alloys can be mixed with the greatest accuracy and poured at the optimum temperatures. Pouring is done by means of hand shanks capable of taking 50 to 60 kgs. (110 to 132 lbs.) of metal from the furnace at a time.

For each type of magnet, metal core-boxes finished with the greatest possible care and precision are constructed (Fig. 1). These core-boxes are mounted on automatic moulding machines capable of a daily output of several hundreds of cores of very fine siliceous sand bonded in a special manner. After being stoved, the cores are stacked one upon the other to a certain height (Fig. 2) and the metal is poured in the centre. The result is a comparatively close cluster of castings which can readily be detached from the central runner by a light blow with a hammer. The flash is then removed from each part by means of a high-speed grinding wheel.

### Close Control Exercised

Finally, after the castings have been cleaned of the very small amount of sand adhering to them, they are sent to the department engaged on the manufacture of the permanent magnets. In this department the castings are machined when this is possible or ground until the predetermined dimensions and forms have been attained. Then, after being finished, they are hardened, magnetised, artificially aged and again checked.

The manufacture of permanent magnets is a much more delicate operation than is generally believed, because even very slight differences in the composition of the metal or slight deviations in temperature during the heat-treatments are sufficient to cause considerable differences in the magnetic characteristics. In fact, the magnetic characteristics depend upon the composition of the alloy, the thermal history of the metal from melting to the finished part, the system of hardening adopted, the decarburisation which may possibly occur during the numerous heating operations and the consequent coalescence of the cementite particles in the case of steels with complex carbides.

The direct production of magnets by casting in the final form affords the following considerable advantages:—(*a*) The elimination of the intermediate heating operations inherent in rolling and forging and always detrimental to the good magnetic qualities of the steel; (*b*) the facility of being able to produce very complicated shapes which could not easily be done by forging or machining. This is of considerable importance to electrical engineers as regards the construction of their apparatus, which is constantly becoming more complicated and outstanding in character.

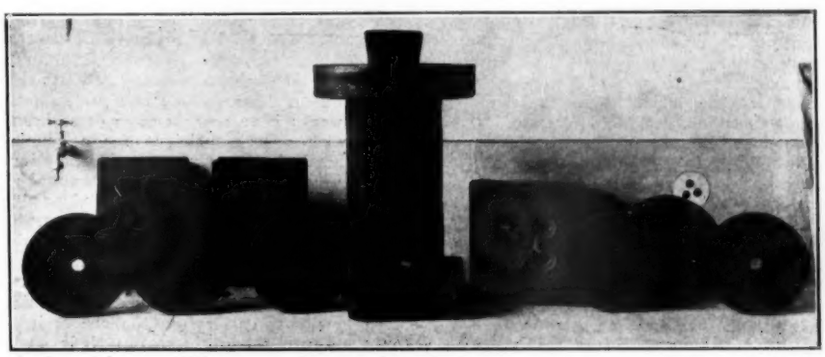


FIG. 2.—CORES, INCLUDING A MOULD ASSEMBLY FOR MAGNET CASTINGS, MADE BY THE FONDERIA MILANESE DI ACCIAIO VANZETTI.

## The Czecho-Slovakian Foundry Industry

(*Continued from page* 70.)

apprentices enrolled, and there are still many young men who are only half-trained, and after several years of inactivity, it is difficult to train them into qualified moulders. To overcome these difficulties, it is necessary to institute a better organisation for the training of apprentices. Much trouble in this direction is anticipated in the near future. This state of affairs is not peculiar to the foundry industry, but extends to every other sphere of activity, not only in Czecho-Slovakia, but in all industrial countries. Much research work has been undertaken in the various foundries, but a lack of co-operation and centralised organisation has acted adversely upon its general value. Again, these conditions are not peculiar to the foundry industry, but are general in character. The principal task of the Czecho-Slovakian foundry industry in the near future is the teaching and training of apprentices and workmen, as well as the organisation of research in foundry technology.

## The Foundry Industry in Scandinavia

(*Continued from page* 71.)

The agricultural implement foundries have been fully employed on account of the continuous modernisation in the farming industry, a necessity due to competition being more severe for dairy products, which is the main activity in Denmark.

Even if the foundry industry has experienced high employment it has no great influence upon the total figure. Unemployment in Denmark is more extensive than in the other Scandinavian countries, a contributing factor being, perhaps, that no real measures against unemployment have been taken either by the government or the municipalities as has been done in the other Scandinavian countries; nor indeed are such measures applicable to Denmark.

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IT IS STATED that negotiations are proceeding for the acquisition of a site in County Cork for the erection of galvanising works with which is associated the name of John Lysaght, Limited.

## Catalogue Received

**Labour Saving Devices.** An eight-page well illustrated catalogue—F 83—received from Herbert Morris, Limited, of Loughborough, illustrates and describes Morris elevating trucks and stackers. The catalogue is general in its appeal and is not addressed to any one particular trade or industry. Actually no foundry applications are given, but they are in use in foundries—especially for shifting stacked boxes of malleable castings.

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### Admiralty Orders

Subject to the settlement of certain points of detail, the Admiralty has decided to entrust the construction of vessels of the 1936 programme as follows:—Aircraft carriers: H.M.S. "Victorious" to Vickers-Armstrongs, Limited, Walker-on-Tyne (machinery by Wallsend Slipway and Engineering Company, Limited); H.M.S. "Illustrious" to Vickers-Armstrongs, Limited, Barrow-in-Furness; coastal sloop H.M.S. "Widgeon" to Yarrow and Company, Limited, Scotstoun.

# The German Foundry Industry

By Dr.-Ing. Th. GEILENKIRCHEN (Secretary and Director, German Ironfounding Employers' Federation)

IN making a report on the development of German foundries in 1936, the chief point of interest will necessarily be an event which for months occupied the attention of foundries and the full activities of their technical and economic associations, namely, the International Foundry Congress in Düsseldorf and the Foundry Exhibition held in connection with it last autumn. Large numbers of visitors from all over the world have been able to see for themselves that the Düsseldorf Congress was one of the most popular and successful which the foundry industry has ever witnessed, and that the Foundry Exhibition provided a complete picture of the entire German foundry industry and the industries catering for it such as has never before been seen in Germany. The German foundry industry made strenuous efforts to ensure that the visit of their foreign colleagues to Germany should be as pleasant as possible and to show them unreservedly all that has been done to build up the industry technically and economically.

It will not be out of place to record once more the feeling of gratification expressed at the International Congress by Mr. Bannenberg, chairman of the Principal Technical Committee, having regard to the fact that these strenuous efforts have met with the appreciation of our foreign colleagues and have helped to strengthen the long-established friendly relations existing among foundrymen throughout the world, a conviction which could be gained above all from the closing session in Berlin and from the speeches made on that occasion by the foreign delegates. In the course of the instructive excursion which afterwards took place through some of the most beautiful parts of Germany as well as through districts of considerable industrial interest, German foundrymen made every effort to show their visitors the most important foundries and associated works without exception, and at the same time to provide them with an insight into the life and activities of the nation, and particularly its development during the last few years under the new *régime*.

## The New Situation

The fact that the Conference and Exhibition could be effectively carried out in such a successful manner is ample proof that, after many years of crisis, the German foundry industry, and with it the entire German industry, is experiencing an economic recovery, the commencement of which was referred to in last year's report. The high-grade foundry products of all kinds on view at the Exhibition could not have been developed in an industry which was unable at least to cover its costs of production in the broadest sense in continuous operation and to make reserves for the future, nor could the foundry equipment industry also have constructed new and better machines had it not been able to sell its products continuously and profitably in the home market.

During many years of restricted employment, German ironfoundries have had to be content with inadequate prices so that, with few exceptions, they have been unable to maintain their working plant at the necessary high level, but since employment has again become normal they have been able to make up for lost time with redoubled energy and to purchase the necessary machinery and plant. A consequence of this is that the foundry equipment works have been guaranteed normal employment and encouraged to improve and cheapen their products, so that even foreign foundries have been able to consider placing orders on a large scale for German machines in competition with the products of other countries. This view has been fully confirmed by the numerous purchases of German foundry machines by foreign firms during and after the Exhibition.

Generally speaking, therefore, it may be stated that the German foundry industry, both as regards the finished structural and consumable castings and also its supplies of engineering castings to the revived German engineering industry, and also the industries which furnish supplies to the German foundry industry, have attained the normal employment corresponding to the full employment of the entire German industry. In a recent important speech, the Prime Minister of Prussia, General Göring, stated that in the course of the past four years German industry has come from a condition of chronic unemployment to a point at which a scarcity of skilled labour is making itself felt everywhere to a considerable extent, and he contemplated that in a very short time Germany would experience a general scarcity of labour instead of unemployment. Conditions are similar as regards employment in the foundry industry.

Although only a short time ago the scarcity of work resulted in a shortage of orders, and the keen competition often forced the prices down to a very unsound low level, German engineering works have now in some cases been provided with orders sufficient for a number of years ahead, despite a very considerable increase in their output—according to the annual report which has just been issued the total production of machines in 1936 was 20 per cent. higher than in the previous year. Consequently the foundries to a considerable extent are also employed to the limit of their capacity, so that at the present time their greatest anxiety is often how they can refuse the orders intended for them without prejudice to their own and the general interests. They are obliged to do this chiefly because their supply of raw materials, both crude metals and scrap, can no longer be adapted to the increasing demand, so that the Government has had to take special steps in various fields to check further increase in production and to distribute the raw materials producible in German works uniformly among the consumers as far as possible. Dr. Schacht, Minister for Economic Affairs, whom the delegates to the International Congress learnt to appreciate as a cool business man with a sound understanding and a warm heart, has for years consistently held the view that Germany can order from abroad only that quantity of raw materials which can be paid for with the currency brought into the country by foreign sales. This principle is to be observed in the future also, even though it will temporarily hamper the output of German industry.

## Minimum Price Increases

The increased employment of the foundries has, of course, resulted in a certain increase in the price of castings. The lines along which the national economy is at present being guided are, however, designed to prevent prices from being adjusted solely according to the law of supply and demand, and consequently from varying within very wide limits, depending on the degree of employment. Instead, the aim is to secure a development which will be as steady and continuous as possible and will exclude fluctuations in price as far as possible. By this means it is intended to prevent the prices from falling in times of economic depression to a level which would no longer ensure a livelihood for the producers, or from rising during an industrial boom.

In accordance with this principle, the costing cartel for ironfoundries, among others, referred to in the last annual report, came into existence before the end of 1935. The result has been that all the German ironfoundries have been obliged to become members of the Association of German Ironfoundries. They are compelled to base their costs of production according to definite uniform instructions and to base their sales on these costs. The costing cartel for ironfoundries has since been followed by a cartel on the same lines for non-ferrous foundries.

## How the Costing System Works

The cartels are intended to prevent certain foundries, in ignorance of their actual costs of production, from selling their products at prices which cannot cover their own costs of production, and thereby disorganising the price levels, as was formerly the case. If, however, as a result of better plant or better organisation, certain foundries are actually in a position to sell at lower prices than other foundries, they are not in any way to be prevented from doing so, but by their example they are to encourage the entire foundry industry to make further improvements. The foundry associations which have been entrusted by the German Government with the execution of this economic plan of national importance have, in the course of the past year, assiduously endeavoured to instruct their members, that is to say, in consequence of the obligatory co-operation, all foundries without exception, in devising rational costing systems and in fixing suitable prices. The fact that these costing cartels have been given power to penalise any failure to follow these principles has already put a stop to unsound price-cutting on the part of some foundries, although it is true that the recovery of the markets has contributed its share towards this.

On the other hand, however, in view of the existing circumstances, costing cartels have to see that prices do not rise above a degree defendable from the point of view of national economy, and to teach foundries which do not exercise this limitation of their own free will that their personal interests must be subordinate to those of the entire national economy of Germany. The logical conclusion of such activities ought to be, and will be, the fixing of standard prices which will guarantee the producer a reasonable profit in both good and bad times, while at the same time protecting the consumer from unjustified rises in price. These standard price lists have not yet been issued by the costing cartels, despite the fundamental approval of the Ministry of Economic Affairs. The associations have, however, carried out extensive preparatory work of an appropriate character, and it is to be expected that the standard prices will shortly be published and will promote a steady and uniform development of the entire industry.

## Repercussion in Design

The shortage caused by the considerable demand for castings also has another very noteworthy effect. It automatically obliges the consumers of foundry products to examine their designs and constructions in order to ascertain whether the same technical results could not be secured with smaller thicknesses of material. In this connection, a great deal has already been accomplished in the last ten years in the field of machine construction. It is beyond doubt, however, that very much more still remains to be

done without having to increase the stress-resisting powers of ordinary cast iron and other cast metals. Apart from this, the efforts made to reduce the thickness of material in structures have been considerably assisted by improvements in the quality of cast iron.

There is no need to dwell on the fact that even cast-iron structures can be considerably reduced as regards the cross-section of the material employed if the mean tensile strength of ordinary cast iron has been increased from about 5 to 9 tons to about 11½ to 14 tons per sq. in., while, in addition, qualities have been marketed in which tensile stresses of 16½ to 19 tons per sq. in. have been attained without any difficulty. The efforts in this direction have been given considerable impetus in recent years by the conception advanced by Prof. Dr. Thum, of Darmstadt, that, in the case of structures, it is not so much the absolute strength, as determined in the position of rest by the application of stress, which is important as the strength of the entire structure under permanent load. At the International Congress, Prof. Dr. Thum, who has already a number of previous publications to his credit, read a Paper* on his investigations which will further the application of even heavy metals to light structural work, so that cast iron will not only regain a prominent position as a structural material capable of withstanding high stresses, but, in addition, the efforts to secure the maximum number of constructional elements from a given amount of raw material will be given an effective impetus. Thus, a transition to new principles is taking place very unobtrusively in machine construction, and in carrying these principles into effect cast iron will play a more important part than it has ever done before.

### Cast-Iron Pipes

As regards the situation of the various markets considered individually, the development of the market for engineering castings has already been outlined, it being stated that the foundries concerned are fully employed and have also been able to improve their prices so as to provide a modest profit enabling them to pay interest on their capital and to maintain their plant at a modern level. Business in the market for structural and consumable castings has not been so steady, however, and in general the situation as regards prices is less satisfactory.

Pipes still occupy the leading position in this field. In this case, however, the revival of employment has improved more in the market for structural work below the ground surface than in the market for work above the surface. Pressure pipes are included in the first category and fall pipes in the second. Employment in the home market for pressure pipes has kept on the same level as in the previous year. Even during the winter months, when business normally tends to be slack, customers' demands have remained at a fair level. Prices have been depressed but have always been adequate. Foreign trade, on the contrary, still leaves something to be desired. As in previous years, the foundries making pressure pipes are endeavouring to maintain foreign sales even against keen competition from other countries, to some extent at a considerable sacrifice. Matters are similar in the fall-pipe market. It was reported last year that, in consequence of the scarcity of lead as a packing material, the pipe foundries had been obliged to change over to other pipe joints, with considerable financial difficulties. At the Düsseldorf Exhibition this year, it was possible to show that these pipe joints are not merely equal to the old pipe joints as regards water-tightness or even air-tightness and flexibility when the pipes are being laid, but are even much superior to them, a factor which in many cases ought to favour the use of cast-iron pipes in preference to stoneware pipes in competition with them.

A relatively large increase in demand is also to be recorded as regards road and domestic drainage castings. Here again, however, prices are such that the firms specialising in the manufacture of these castings are only just able to make a living. The situation of the radiator and heating-boiler market has improved satisfactorily not only because the building trade is still very active, but also because many old buildings have been fitted with central heating. The market conditions in the case of sanitary castings have not altered much. To some extent, production still exceeds sales, and the prices are often very considerably depressed. Home business with regard to baths has been brisk, but the foundries making baths have had no difficulty in coping with German orders and in order to utilise their capacity to the full, have had to turn to export, which still leaves much to be desired, because in the countries which are capable of absorbing the products, building activity has not reached the same level as in Germany. As regards prices, some steadiness has been brought about by an international agreement.

The situation as regards fitted goods is good and to some extent an increase is to be observed in the home demand. Business in stove and hearth castings has not shown any particular recovery, and stove manufacturers have experienced difficulties in maintaining the export to countries capable of absorbing these products, chief of which is Holland. These difficulties have been intensified by the depreciation in currency in various countries.

### Non-Ferrous Castings

In the field of non-ferrous castings, the foundries have had to face some difficult problems owing to the scarcity of various metals previously employed, and State control of consumption has had to be introduced. Even in this connection, however, it may be stated that up to the present it has always been possible to meet the requirements in those cases where metals which are difficult to procure are absolutely necessary. In such cases, the prices always depend upon the international market.

In conclusion, it may be stated that the entire German foundry industry has passed through a year of hard work and also of success, and is entering the New Year with the wish that its efforts will be crowned by the same technical and economic success. It would be a mistake to deny that, in carrying out its tasks, the foundry industry has had to overcome many difficulties which, in view of Germany's peculiar position, are much greater than in other countries. Foreign colleagues, who at this year's International Congress gave expression in such an outstanding manner to their close association with German foundrymen, will fully appreciate the efforts of the latter to overcome these difficulties. The German foundry industry will also always be willing to co-operate in future to the utmost of their ability with their colleagues throughout the world in solving not only the technical and economic problems of foundry practice, but also the much more important problem of promoting understanding between the nations.

* Abstracted in the FOUNDRY TRADE JOURNAL, October 1, 1936, p. 247.

# Foundry Trade on the Rand

## FROM A SOUTH AFRICAN CORRESPONDENT

AS a result of the growing importance of the foundry trade in Johannesburg and the surrounding cities, it has been decided by the local leaders of the foundry trade to establish in South Africa a Branch of the Institute of British Foundrymen, a step which it is anticipated will result in considerable technical advances in the South African trade. A Branch committee is to be formed under the chairmanship of Mr. T. Nimmo Dewar, a managing director of the Union Steel Corporation, Limited.

In an interview Mr. Dewar emphasised how important the foundry trade had become in South Africa and what important developments are sure to occur with the rapid expansion of mining, industry and the railway service. The progress of the mining industry, in particular, is bound up with the Johannesburg foundry trade. Mr. Dewar pointed out that in one year a million pounds' worth of castings is supplied for the Witwatersrand area alone, and, naturally, every extension in that industry means a greater demand for castings and foundry work.

It is easy to understand how the trade developed in South Africa so quickly, said Mr. Dewar. Being situated 6,000 miles from the foundries of Great Britain, it was impossible to get new castings or replace old ones quickly, and in the mining industry speed is essential. Not only in mining, but in every branch of industry is the work of foundrymen needed. The importance of the new Branch it is proposed to start is that foundrymen in South Africa will be able to avail themselves of all the latest technical knowledge acquired by the industry in England on such necessary points as mass production, lowering of cost, and the soundness of materials.

Although this development is occurring in Johannesburg, it will probably be extended to the other parts of the country, such as the Cape, where a considerable amount of foundry work is also undertaken.

### Manchester Association of Engineers

The Manchester Association of Engineers have produced a very interesting propaganda booklet describing the work and ideals of the Association. It is available to our readers on request to the secretary, Mr. T. Makemson, St. John Street Chambers, Deansgate, Manchester.

## Dates and Data

(*Concluded from page* 65.)

mounted by a picture, "Peg o' My Heart"—this firm is invariably successful in its choice of subject; from the MORGAN CRUCIBLE COMPANY, LIMITED, Battersea, London, S.W.11, a monthly tear-off wall calendar of unique aspect, as it carries illustrations reproduced from "De Re Metallica" (1494-1555). This type of illustration appeals to one in some subtle way; we suppose it is a subconscious effort to find some detail which we imagine has escaped general notice; from JOHN A. SMEETON, LIMITED, 17, Victoria Street, London, S.W.1, a daily tear-off wall calendar mounted on stout silver cardboard with raised lettering in blue issued by its principals, the BOCHUMER VEREIN—the days are printed in English; and from the STANDARD BRASS, IRON & STEEL FOUNDRIES, LIMITED, Benoni, South Africa, a monthly tear-off wall calendar of large dimensions, each page of which is surmounted by an aerial view of the works. Amongst Christmas cards received, we appreciated very sincerely the good wishes from DR. J. J. C. BRADFIELD & SONS, consulting engineers, of Barrack Street, Sydney, Australia.

TWENTY-TWO ENGINEERING STUDENTS from the University of Cape Town made a tour of inspection of engineering works on Tyneside during the current week.

# The Polish Foundry Industry

By G. GIERDZIEJEWSKI (President, Foundry Group of the Polish Metallurgical Industries Federation)

WHEN the Editor of THE FOUNDRY TRADE JOURNAL suggested to the author that he should prepare a Paper dealing with the Polish foundry industry, he readily accepted, as the English Papers contain so very little information upon the subject. Moreover, it should be borne in mind that the International Foundry Congress will be held in 1938 in Poland.

At the beginning of 1936 there were in active operation in Poland 498 foundries, of which 84 were making builders' castings and the like; 161 cast iron for machinery; 25 manufactured malleable iron; 30 steel; and 198 non-ferrous metals. No fewer than 15,000 workmen were employed by the whole of the foundry industry in Poland, and 1,200 people held positions in the technical and administrative departments.

In 1935 the output was 110,000 tons of iron and malleable iron castings, and the general turnover of the foundry industry was 75 million zlotys (*i.e.*, about £2,900,000), of which iron castings accounted for 55 million zlotys, steel castings 15 million zl. and non-ferrous metals castings for 5 million zl. The wages paid by the industry were about 20 million zlotys (about £750,000). Business in the Polish foundry industry in 1935 was at a comparatively low level, and did not exceed 45 per cent. of the possible production.

These figures should be compared with the production in 1929, the best year for the foundry industry in Poland, as in most countries, when about 217,000 tons of iron castings were made.

PROF. G. GIERDZIEJEWSKI.

### Production Statistics

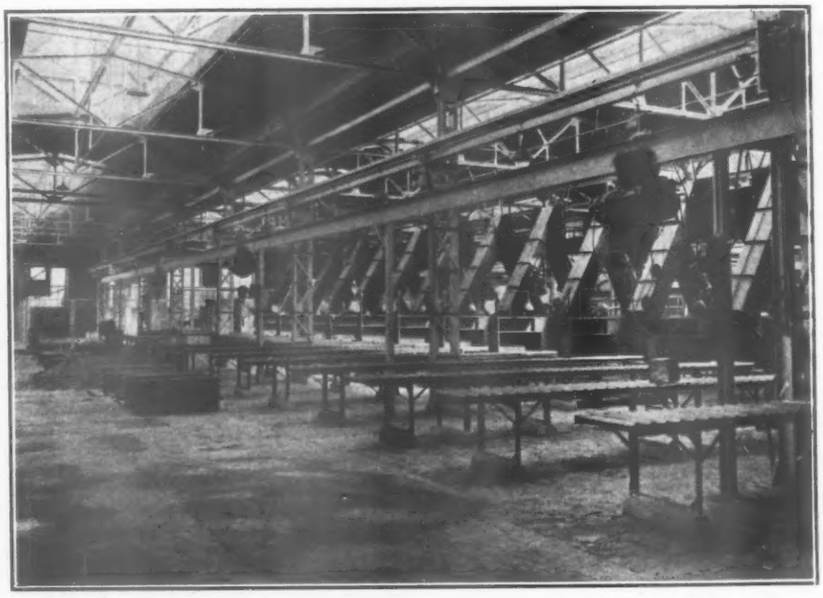
For the production of 110,000 tons of iron castings, the industry used about 56,800 tons of pig-iron, of which 53,300 tons were produced in Poland and the balance imported, mainly from England and Sweden for special castings; 90,500 tons of scrap, including 25,500 tons of imported material; and 48,500 tons of coke, of which 19,400 tons were imported from Czecho-Slovakia (Karwinsk), situated near to the South-West frontier of Poland. Of the 110,000 tons of iron castings made in 1935, about 75 per cent. were consumable castings, the balance being for the construction of machines.

Passing to an examination of the structure of the Polish foundry industry, it can be stated that of the 270 iron foundries active in 1935, about 40 foundries represented 85 per cent. of the whole of the production; the remainder, *i.e.*, about 230 foundries, being very small and technically on a very low level, represented 15 per cent. of the total production. It is believed that similar conditions obtain in the foundry industry in Czecho-Slovakia, and to a lesser extent in France and elsewhere. The steel foundries are, in general, larger concerns; they are situated near the large blast furnaces or engineering works, and are definitely modern in design and construction.

### Non-Ferrous Foundries

Of the 198 non-ferrous foundries, only 20 per cent. are modern, and many are large shops, serving important concerns fabricating all kinds of fittings, etc. At the present time, the Polish foundry trade is able to meet the demands of national industry, not only as to quantity, but also as to quality of their productions, which are often quite as good as those of foreign manufacture, even if the latter be of world-wide reputation.

The railway industry (cylinders, etc.), the motor vehicle industry (motor-cars, motor-cycles) and the aircraft industry (aero engines, etc.) are completely satisfied by the national foundry products. Parenthetically, it can be stated that the Polish aircraft industry is on a very high level, and is co-operating with England, particularly as regards licences of some English firms.



A MODERN POLISH NON-FERROUS FOUNDRY. EXTENSIVE USE IS MADE OF OVERHEAD SAND SUPPLY AND ROLLER PATHWAYS.

### New Methods Used

All the newer methods of foundry production are widely used in Poland. These include modern methods of melting, such as the use of both electric-arc and high-frequency induction furnaces. There are two installations of the latter type in the country, whilst a third is under construction. Other recent innovations include the centrifugal method of making pipes, chill and die castings, etc., all of which are quite extensively employed.

The Polish light alloy foundries, produce, *inter alia*, all types of aluminium alloy castings, such as Silumin (Alpax) "Y" alloy, Hiduminium RR, etc., as well as magnesium castings (Elektron metal), using the licence of I.G.A. Farbenindustrie.

### Consumable Castings

Prominent amongst Polish firms making consumable iron castings are Herzfeld & Victorius in Grudziadz, with an annual production ranging up to 20,000 tons, and the pipe foundry in Wegierska Górka, with about the same production. It is interesting to note that this latter concern is under the direction of Prof. J. Buzek, the author of the well-known theory of combustion in cupolas, published for the first time in 1910 in "Stahl und Eisen," and later specially developed by Prof. Geiger in his well-known four-volume "Encyclopædia of the Foundry Industry." Then there is the foundry of J. Witwicki, possessing one of the most modern enamel-shops in Europe, specially designed for the production of baths.

Another high-grade concern is the pipe foundry of Zaklady Ostrowieckie (Wielkie Piece i Zaklady Ostrowieckie w Ostrowcu), which employs the Delavaud centrifugal casting system. Others worthy of note are the radiator and central-heating boiler foundry at Starachowice; J. John, Limited, and S. Weigt & Company, both situated in the Lódź; and the large foundry of Zieleniewski & Fitzner-Gamper in Cracow. The last-named foundry operates under a licence of H. Lanz for the production of "Perlit" iron. Just as important are the foundries of "Huta Zgoda," capable of making iron castings weighing up to 75 tons each; the Zaklady Metalurgiczne of Państwowe Zaklady Inżynierji, which manufactures aluminium alloy castings under licence granted by High Duty Alloys, Limited, of Slough; and the firm Lilpop,

Rau & Loewenstein in Warsaw, which is a large modern foundry working for the motor vehicle industry; and the important works of E. Erbe, which makes malleable iron castings and exports the major portion of its output—a condition applicable to best Polish foundries.

THE STEEL FOUNDRY OF LILPOP, RAU & LOEWENSTEIN OF WARSAW. ELECTRIC MELTING FURNACES ARE USED.

Whilst Poland does import iron castings, on the other hand it exports consumable castings, and the extent to which this business was carried on in 1935 was 2,724 tons; the maximum export was reached in 1928, when 7,065 tons were sent abroad.

## Organisation of the Polish Foundry Industry

The industry is not yet completely organised, but during the last few years much progress has been registered. The organisation of the Polish foundry industry operates in three distinct directions:—

*Economic.*—This branch controls the general policy of the foundry industry, and is centred in the Foundry Group of the Polish Association of the Metal Industries, which in recent years has been extremely active. It maintains a register of all foundries in Poland and compiles statistics of production, of imported materials, especially scrap, etc. The industry now works on the complete acceptance by all Polish foundries of a unified system of calculation of initial cost, which has greatly assisted its general rationalisation.

*Technical.*—This aspect has for some time been centred in the Foundry Circle of the Association of Polish Technicians. This body is a member of the International Committee of Foundry Technical Associations, and is well known in England by contact with its members, who invariably represent the Circle at International Congresses. The Foundry Circle, which was founded 8 years ago, recently became an independent technical association of Polish foundrymen and has taken on the responsibility of the organisation of the International Foundry Congress to be held in Poland in 1938. During its existence, the Circle organised three national foundry congresses, which had the co-operation of foreign organisations. The Circle also has taken part in all the International Foundry Congresses since 1929, and Papers by Polish authors were presented at the congresses in London, Milan, Prague, Paris, Brussels and Düsseldorf.

*Trade Associations.*—Apart from the above organisations, there exist organisations of a purely commercial type, aiming to regulate prices and conditions of production. Amongst these are the Polish Steel Foundry Federation, "Ruropol," and others which have organised the Polish foundries making water and gas pipes, makers of boilers for central heating and radiators, and another one for the manufacture of baths. One important organisation to which the majority of "consumable" cast-iron foundries belonged is now in liquidation, but it is confidently expected that soon it will be resuscitated under conditions of mutual benefit.

In spite of the existence of many associations and agreements dealing with the prices of saleable iron commodities, the prices are, in general, too low, and competition, particularly by a large number of the smaller foundries, forces the more important concerns to suspend the production of some articles, because quite often the prices quoted are lower than the works cost. Thus, the economic situation of the foundry industry, especially the iron-foundry section, is poor, and tends to prevent the modernisation of existing plant.

The foundries attached to engineering works are operating under much better conditions, but they also do not receive adequate recompense for their labours. It must be stated, however, that the Government completely realises the needs and the importance of the foundry industry, as a fundamental part of the heavy metallurgical industries, and it is hoped that, with this support, the activity of economic organisations will give better results in the profit-making ability of the foundry industry.

In 1936 the production of castings in Poland was unquestionably much higher than that of the previous year. At the time of writing insufficient data are available to make a reliable estimate, but probably it will exceed 125,000 tons, *i.e.*, it will be about 15 per cent. higher than in 1935.

## Foundry Apprenticeship

In conclusion, the author would like to deal briefly with the question of foundry apprenticeship in Poland. Foundry technology is taught in the Metallurgical Academy at Cracow, and at the Faculty of Mechanics at the Polytechnic High School in Warsaw. These schools pass out every year a number of technicians qualified both theoretically and practically, having real knowledge of the modern problems of foundry technique. There are also some higher grade technical schools in which the foundry trade is taught, but generally speaking the training of the skilled men is done by large Polish foundries themselves, by direct teaching in the actual shops. In some cases the lads are given a certain amount of theoretical knowledge of modern foundry problems. For the selection of apprentices, some foundries are using psycho-analytical examinations.

THE CENTRIFUGAL PIPE SHOP OF OSTROWIECKIE IN POLAND. THE DELAVAUD SYSTEM IS USED.

This short survey of the industry will, it is hoped, encourage British foundrymen to make a closer acquaintanceship with a country which is but little known to them, by visiting Poland in 1938 for the International Congress.

# The American Foundry Industry in 1936 and Its Prospects for 1937

## By OLIVER SMALLEY (H.B.M. Consul, Pittsburgh)

DESPITE higher wage costs, increasing taxes, advancing raw-material prices and labour threats, the American foundry industry as a whole has good reason to feel satisfied with the year 1936. Recovery in the capital or durable goods industries, from which the foundry industry derives most of its business, commenced some eighteen months ago and has continued to expand all through the year, and, excepting unexpected catastrophies, is likely to continue through 1937 into 1938.

Besides the natural desire for all foundries to make a profit and pay off indebtedness incurred during the extended depression years, this improvement in business has been particularly welcome because of the obsolescence of the foundries themselves, buildings, equipment and methods. Therefore, possibly the outstanding event of the year was the well-timed Foundry Equipment Exhibition at Detroit, in May, organised so capably by Mr. C. E. Hoyt, Executive Vice-President of the American Foundrymen's Association.

At this exhibition there was, on the whole, little that was new. The foundry equipment showed that manufacturers have spent considerable time in perfecting lines which were shown originally at the Philadelphia Convention in 1934. Methods for rapid cleaning of castings, air-purification systems to combat silicosis, increased output from moulding machines, improved sand-handling equipment and conveyor systems were really the main features of the show. The keynote of the exhibition as a whole was speed.

### Steel Castings

Commercially, the steel casting industry has almost doubled the sale of its product this year, due in no small degree to the release of many orders for railway wagons for the various railways of the U.S.A., and the railway specialty foundries have enjoyed a greater than average increase in their business for this reason. Selling prices showed little change over 1934 and 1935.

### Developments

The depression years have left most steel foundries in a poor condition, and what profits are now being enjoyed are having to be put back into plant and equipment restoration, involving installation of modern core-drying and annealing ovens, pattern-storage facilities, sand handling, sand-preparation equipment, dust arresters, roller conveyors and improved fettling shop equipment, etc.

The smaller electric steel foundries have had to resort to expansion of melting capacity, and many of them have been putting in small electric furnaces to take care of special alloy heats without interference with the heat schedule for their main melting unit.

The Randupson process of using cement-bonded silica blocks for the manufacture of large steel castings has been employed by one large steel casting company and is being tried in an experimental way by others, but it cannot be said to have made any serious progress as yet in the States.

Metallurgically, progress seems to have been confined to more rapid melting and producing a greater percentage of sound defect-free castings; there has also been a great deal of emphasis placed upon economies in operation, both in the thinking and policies of the industry as a whole.

The trade association of the steel casting industry, viz., the Steel Founders' Society, has been unusually active. An advertising and sales promotional campaign has been carried on during most of the year, which has secured some results in the form of actual casting orders for members. Engineers have been given a clearer picture of what the industry's products can do for them. The Society has lost no members, but obtained one new member, showing that the foundries are co-operative and desirous of protecting a "fair trade practice code" for the industry.

### Malleable

There has been little or no appreciable expansion in the malleable castings business during 1936 along lines of production. While it is true that tonnage output in 1936 was considerably in excess of 1935, this increase has been obtained by a higher rate of operation, speeding up manufacturing processes, particularly that of annealing rather than to any enlargement of plant capacity.

MR. O. SMALLEY.

There have been no noteworthy developments metallurgically. The American Society for Testing Materials has published a useful Symposium on Pearlitic Malleable Cast Iron, which, although containing nothing that is absolutely new, should be in the hands of all British manufacturers of malleable cast iron.

Electric annealing does not seem to have made the headway in the industry that was expected of it a few years ago, and to-day is used only by a comparatively few producers, and even then only where iron of special properties and characteristics are desired. It is personal understanding that it is possible to-day, other than with electricity, to obtain almost the same close controls of temperature.

Cost of manufacture as a whole has advanced steadily during the past year, and the increase has been due more particularly to higher cost of materials than of labour—both of which have risen steadily. The selling price of finished castings seems to have remained fairly constant, and has not yet reflected the increase of cost of manufacture.

The Malleable Founders' Society is much the same as it was last year so far as its membership is concerned, and almost the entire production of jobbing malleable iron is enrolled. The principal activity of the Society has been sales promotion, using the instructional engineering line of approach rather than to advertise by direct mail or through trade papers.

Labour situations common to those of other branches of the foundry industry have been generally satisfactory. Increased wages have been paid and almost every producer has given further increases or bonuses during the last quarter of the year.

### Grey Iron

The attention of the grey iron founder has been confined mainly to production problems and getting his foundry on a profit-paying basis. The depression has left the industry as a whole both undermanned and unfit to meet the demands now being made on it. The only foundries that are making money to-day are those which have been able to keep their plant and equipment up to date and that are selling on a quality basis.

Metallurgically, new developments are few. There has been an expansion in the use of alloys and in further improving the general quality of castings. Significant study has been given to a better understanding of such engineering properties as fatigue, torsion, impact, hot creep strength, damping capacity and so forth. The American Cast Iron Pipe Company, continuing their work on hot-blast cupolas, have developed a hot-blast system that can be applied to small cupolas for short heats.

Heat-treatment of cast iron is receiving wider recognition. Flame-hardening, using an oxy-acetylene or gas flame for local hardening, whilst old to the steel industry, is receiving an impetus in its application to cast iron. This year has seen a continued growth of the application of this process to the local hardening of dies and press tools, gear wheels, cams, guides for machine tools, drilling heads, and so forth.

The Grey Iron Founders Society, the acknowledged trade association of the industry, has had, possibly, a greater struggle in recovering from the death blow to the National Recovery Act made by the Supreme Court in the spring of 1935, than any other national trade association. This year, the activities of the Society seem to have been concentrated in clearing away the debris left after the sudden demise of the Blue Eagle and in organising its new programme. This latter intends to follow, more or less, the plan given in the author's last annual report, except that it has been supplemented by: (1) The creation of a free employment service bureau for skilled foundrymen; (2) an advertising campaign to challenge the destructive and hostile advertising and publicity against cast iron, which so many competitors seem always to use as a target, and (3) to interest itself again in the technical and engineering advancement of grey iron.

There is no doubt that the grey iron industry of the U.S.A. needs this trade association badly, for it is almost pathetic to see the many foundries that not only have no conception of what goes on in the world, but seem to have no way of helping themselves; and what is possibly worse, seem unable to better their lot.

### Labour

There have been virtually no disturbances in the foundry industry, but the current year is

expected to be particularly noteworthy with respect to new legislation designed to raise labour standards. A wave of wage increases and profit-sharing bonuses is currently sweeping the country in the greatest movement of this nature since the war and a shortage of skilled moulders is noticeable. Since only about 10 per cent. of the workers in the U.S.A. are organised, the trade union situation is very different from that of the United Kingdom. With the sympathetic attitude of the present administration to support labour unions, the large funds of existing labour organisations and the labour legislation likely to be enacted by the next Congress, further unionisation of foundries and maybe some labour disturbances are in store during the coming year.

### Prospects for 1937

The aggrogate increase in industrial production for 1936 approximates to 17 per cent. as compared with 1935. A continued increase seems likely for 1937, but estimates are that it will be less than for 1936, possibly only 12 per cent., and durable goods lines will improve more than consumer goods. Substantial expansion in the heavy industries, railways equipment, locomotives, electrical equipment, machinery, building, steel, automobile, farm equipment, and chemicals, etc., seems assured and augurs well for the foundry industry as a whole.

*Railways and Equipment.*—Obsolescence has expanded the replacement in railway equipment to huge proportions, and with the prospect that railway revenues and earnings will expand swiftly with improvement in the durable goods industries—because coal, ore, steel, lumber, cement and building materials must move by rail—the railway equipment industry will be called upon for an annual output of locomotives, passenger coaches and goods wagons in considerable excess of the estimated production of 1936. At present over 62 per cent. of the locomotives in use are twenty years or more old and over 58 per cent. of the goods wagons are over fifteen years old. The railway equipment industry has begun, during 1936, to show the impetus of this enormous potential demand and a sharply increased number of orders have already been received in all the major divisions of the railway equipment business. Particularly good times appear in prospect for those foundries specialising in this branch of industry.

*Industrial Machinery.*—Replacement due to old age; obsolescence due to development of more efficient equipment; new manufacturing methods demanding new types of machinery and the necessity of reduced manufacturing costs due to increasing wage scales, are all major factors working in favour of a sharp upturn in the total machinery demand. Manufacturers of virtually every type of industrial machinery experienced large increases in their orders during 1936, and most have on hand large volumes of unfilled orders.

There are clear indications that this heavy industry will experience a substantial expansion during 1937, and as the jobbing foundries are now unable to cope with present business, their problem will obviously not be lessened during the forthcoming twelve months.

*Farm.*—With farm purchasing power approaching that of 1929, reflecting prospective large crop yields and maintenance of higher prices, the agricultural machinery industry should also experience a restoration of sales volumes and earnings to levels comparable with those of previous prosperity years.

*Motor Vehicles, Lorries, and Accessories.*—This industry led the way to recovery from the depression and it is likely to remain in the forefront of industrial expansion in 1937. Statistics estimate 1937 motor vehicle production at more than five million cars. Lorry sales in the first ten months of 1936 exceeded the entire year of 1929—the previous peak. Substantial additional casting business from motor vehicle parts and tyre makers is anticipated.

*Electrical Equipment.*—Because of the greatly increased electrical power demand and the limited capacity, a heavy capital investment in new electrical machinery is imminent. Potentialities of the electric power industry over a period of years overshadow those in any other major industry and mean substantial casting business, particularly to the large foundries.

*Iron and Steel.*—Reorganisation of the steel industry to improve operating efficiency—involving almost rebuilding and modernising nearly all large plants—is reflecting itself in the enormous pressure of business in those foundries specialising in mill equipment, rolls and the like, and the demand for which is likely to continue for some time to come.

*Building.*—It is significant that while the improvement in demand for most of the durable goods industries has been substantial during 1936, the building industry has lagged behind. This unquestionably is caused by the low demand for commercial office buildings and residential flats. However, 1937 is expected to show substantial gains because of expansion in utility and industrial construction, also because of an upward trend in residential building and the Federal Government's efforts to stimulate slum clearance and better housing schemes.

In conclusion, it is felt that excepting unforeseen world catastrophies, the cyclical expansion in business is likely to continue in the foundry and foundry equipment and supply business well through 1937 and into 1938.

# Foundry Plant and the U.S.S.R.

## PAST PURCHASES AND FUTURE PROSPECTS

SINCE 1929 the Union of Socialist Soviet Republics has imported huge quantities of foundry plant and machinery to cope with the requirements of the Five Year Plan. How great the imports have been is probably only known to the Russian importing authorities themselves. Most of these orders have gone to Germany, and it is occasionally possible to have a glimpse of the extent of the business done from the lists of users and the statistics which are published by many of the foundry plant makers in that country. One single maker of sand mills supplied over seventy machines to the U.S.S.R. in a period of five years, no less than twenty-one having been delivered to the Cheliabinsk Tractor Plant and another eleven to the Charkov Tractor Plant. Orders for complete sand-preparing installations have also been numerous, quite apart from the thousands of moulding machines, electric furnaces, and other items of foundry equipment imported during the same period.

German foundry-machinery circles have of late been seriously concerned over the decrease both of inquiries and orders from this important market during the present year. The reason for this is not to be attributed altogether to political tension between the two countries, but is to be found in a recent article appearing in "Sa Industrialisaziiu," according to which thirteen new types of foundry machinery are to be added to the existing output of a Russian works already specialising in this field. The works in question is "Krassnaia Pressnia," of Moscow, originally founded in 1884, but so modernised under the Five Year Plan that according to the same journal it produced during 1936 foundry plant (chiefly fans and moulding machines) to a total value of some 8 million roubles, all of which plant had formerly been imported from abroad.

### The Future

It is officially stated that as a consequence of the progress made under the second Five Year Plan from the year 1937, everything possible will be done to reduce imports of foundry plant of a kind which can be produced in Soviet works. It has to be remembered, however, that this policy of restricting imports is one which is by no means confined to Soviet Russia, but it is a truism that no industrial country has yet succeeded in making itself self-sufficient in regard to modern engineering plant and equipment, and it is, to say the least of it, exceedingly doubtful whether the U.S.S.R. can ever afford to stop such imports. There is no doubt, however, that the time for securing "easy" orders has now definitely passed, that is to say the period during which manufacturers of foundry plant and machine tools in Germany, England, or the U.S.A., with no knowledge or experience of the Russian market and without taking any steps whatever to cultivate that market could yet count upon receiving almost automatically both inquiries and orders for their productions without any necessity for any longer journey than was involved by an occasional visit to the offices of the appropriate Soviet buying organisation in Berlin, London, or New York, as the case might be.

In future it is certain that to secure such orders for foundry plant much hard work, organisation, and study of the market will be called for, as is involved in cultivating any other field of export trade. There is no doubt that the Soviet's requirements of the simpler types of foundry equipment can now be supplied entirely from their own works, but there are numerous items of foundry plant of a more complicated nature such as certain types of moulding machines, special drying ovens, automatic sand-preparing plant, electric furnaces, and certain classes of melting plant in which there will always be a certain amount of business. The machine-tool trade has found by experience that it is the highly industrialised countries which, in spite of local competition, offer the best markets for the highest class of machine rather than the agricultural countries, and makers of high-class foundry plant throughout the world will find that the U.S.S.R. since its metamorphosis from an agricultural to a highly industrialised State will always provide a regular market for any machine or item of equipment which can show definite advantages, although such demand will naturally never equal that of the years 1929 to 1934.

There are now many hundreds of foundries in existence in U.S.S.R., not all of them so large or mechanised to the same extent as the tractor and automobile plants in Moscow, Gorki, Cheliabinsk and elsewhere, but in all of them the technical and operating staffs are attempting to find means for increasing their production or, what is occasionally even more important, improving the quality of their output, especially since the inception of the Stakhanov movement. In spite of the existence of central importing organisations, trusts, planning offices for works equipment, and all the other machinery of bureaucratic control, it is ultimately the personnel of the individual foundry which is responsible for results, and it needs actual experience with a few of these foundries to appreciate how greatly the technical staff desire to increase their knowledge of foreign and alternative methods and results.

# The South African Foundry Industry

## By A. H. GUY (President, Transvaal Engineers and Allied Metal Trades' Federation)

IN response to the Editor's request, the author has reviewed the position of the foundry industry in South Africa, but it is feared that the time available in which to accomplish the task is inadequate, since the foundry industry is spread all over South Africa, each area having its own history, that of the Transvaal aligning itself with the mining industry. Its infancy started with the discovery of the Witwatersrand, while industry in the coastal area can be traced back to the time of the inauguration of steamships on the South African route.

Prior to that there may have been a certain number of primitive foundries to supply the demands of wagon building and farm requirements. Later, the inception of the sugar industry in Natal inevitably caused a demand for castings to meet the requirements of the sugar mills. This, then, must be regarded as the start of the foundry industry. Perhaps it will be most advantageous if this review be confined to the Transvaal only, and the rest of the country be left for consideration in a later and more complete article.

It is difficult to separate foundry and general engineering shops, since, with only two exceptions, all shops might be termed jobbing foundries. There are probably only two purely foundry companies in the Traansvaal.

Up to 1914, when the Great War started, the local foundries only supplied spares for pumps and running repairs of plant for various industries, and when South Africa became isolated and England concentrated on the manufacture of munitions, the gold mines encouraged production of all their requirements. This naturally gave the necessary stimulus, and, since then, the expansion has been rapid, so much so, that, with the exception of machine tools, practically all castings used by the mining industry are now produced locally.

MR. A. H. GUY.

It is only in recent years, however, that any attention has been given to alloys, or that laboratories have become a part of foundry control. This will receive greater encouragement now that a Branch of the Institute of British Foundrymen has been started under the ægis of all the leading foundries.

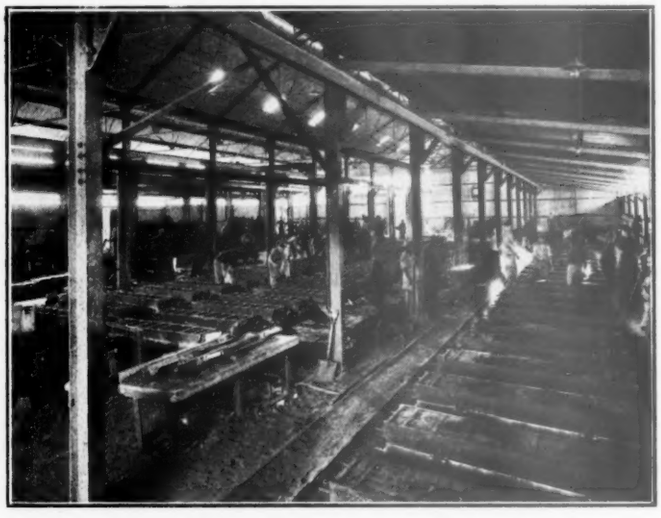
As in the United Kingdom, the leaders of the industry have been very chary of mechanising their shops, but, with the adoption of mass production methods, moulding machines now appear to be adopted as standard equipment.

It must be borne in mind that this country does not export manufactured products, and that its expansion is more or less governed by the expansion of the gold mining industry. The tendency is for a very much more rapid and wider expansion in the future, since the question of the production of munitions in this country is imperative.

Another urgent question is that of absorbing the local abundant supply of dormant raw materials. It must not be forgotten that the industry is 7,000 miles distant from normal supplies, and that the gold mining industry must be maintained at maximum efficiency, and it is essential that its source of supplies must be close at hand. This makes it obvious that the foundry industry is the key industry in time of war and stress. It is also the policy of the Union Government to encourage employment of the maximum number of Europeans, and it is only the craft industries which are able to do this.

While not having any connection with this article, which is intended to be a brief review of the history of the foundry industry in South Africa, the suggestion is put forward that United Kingdom commercial and industrial undertakings make representations to the President of the Board of Trade concerning the export of supplies to the Dominions and Colonies.

The British export trade, which has been so laboriously built up over the past twenty years, is now in danger of being lost to foreign countries as deliveries in future can only be made in from nine to twelve months. Other countries are quite aware of the handicap British industries are suffering, due to the increased manufacture of munitions, and it should be made clear to the British Government how difficult it will be to recover the trade once it is diverted to other countries, who are now obviously making great efforts to secure this trade.



LIGHT CASTINGS BAY, CITY ENGINEERING WORKS, PRETORIA.

MAIN BAY, SHOWING CUPOLAS, CITY ENGINEERING WORKS, PRETORIA.

## Catalogue Received

**Spun Iron Pipes.** The art of photographic reproduction and technological data have been splendidly blended in the latest brochure, dealing with "New" spun iron pipes, issued by the Stanton Ironworks Company, Limited, near Nottingham. The appellation of "New" has reference to the application of the "Mairy" heat-insulating process to the older and eminently successful Delavaud method. A thin coating of powdered ferro-silicon is applied to the rotating mould which eliminates chill and produces a fine-grained structure. The amelioration which such a simple process can communicate to the physical properties of a cast pipe is surprising.

# Recent Developments in Testing Oil-Sands for Cores

## By N. D. RIDSDALE, F.C.S.

IN a recent article reviewing the present position of moulding sand tests in Great Britain by the author,* it was shown that most of the tests investigated up to the present deal with green-sand and dry-sand, but not to any great extent with oil-sand.

Since oil-sand is now used extensively for cores, the author has investigated methods of testing with a view to recommending simple, reliable, routine tests of practical value to the foundryman. These tests cover the following properties:—

On the oil-sand as prepared:
- Green bond strength.

On the baked test pieces:
- Compression strength.
- Shear strength.
- Tensile strength.

### Green Bond Strength

Information about the green bond strength is important in connection with the handling of oil-sand cores so as to avoid distortion before baking. Ordinary oil when added to sharp sand gives a mixture having very little green strength. Green strength may be imparted (*a*) by adding a proportion of ordinary clay-bonded moulding sand; (*b*) by adding a mixture of cereal pastes; (*c*) by using a proprietary core *paste* (as distinct from an *oil*). Table I illustrates the properties of oil-sand containing respectively:—(1) Clay-bonded sand; (2) core paste, and (3) oil only.

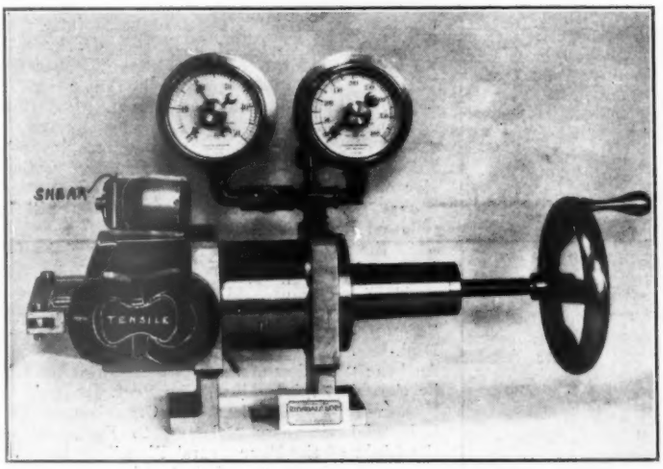



FIG. 1.—BUCHANAN'S DESIGN OF HYDRAULIC COMPRESSION STRENGTH TESTING MACHINE ADAPTED TO MAKE TENSILE AND SHEAR TESTS.

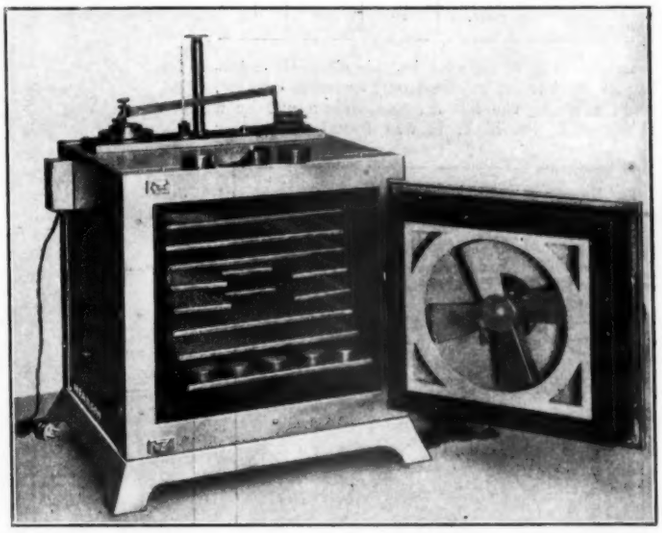


FIG. 2.—SPECIAL OVEN, WITH ELECTRO-THERMOSTATIC CONTROL AND FANS FOR AIR CIRCULATION.

TABLE I.—*Properties of Oil-Sand Cores.*

| | No. 1. With clay-bonded sand. | | No. 2. With core paste. | | No. 3. With oil only. | |
|---|---|---|---|---|---|---|
| | Green. | Baked. | Green. | Baked. | Green. | Baked. |
| Permeability No. .. .. .. | 29 | 48 | 117 | 200 | 69 | 103 |
| Compression strength (lbs. per sq. in.).. | 2.3 | 107 | 2.4 | 425 | 0.9 | 105 |

No. 2 is a different sharp sand from that used in Nos. 1 and 3. However, the tests show clearly that the introduction of clay-bonded sand to the No. 3 oil-sand mixture to produce No. 1 mixture reduced permeability, after baking, from No. 103 to No. 48, whilst the green permeability is reduced from No. 69 to No. 29. The compression strength after baking is practically unaltered, viz., 105 lbs. per sq. in. in No. 3 and 107 lbs. per sq. in. in No. 1.

In No. 2 mixture using a core paste it will be seen that the sharp sand retains a very high permeability, viz., No. 200 after baking and No. 117 in the green state. It will be seen that the green compression strength in No. 2 mixture using the core paste is quite satisfactory, viz., 2.4 lbs. per sq. in., which is practically the same as the "green" compression strength in No. 1 mixture (which contains clay bond sand), viz., 2.3 lbs. per sq. in. These experiments indicate the value of sand-testing in bringing to light the advantage of using a core paste in preference to clay-bond moulding sand for obtaining the necessary green strength.

### Compression, Shear and Tensile Strength

Compression strength is the only test for which the hydraulic machine recommended by the Institute of British Foundrymen's Sands Sub-Committee of the Technical Committee was designed. Recently the author has adapted this machine so as to make both tensile and shear tests of baked oil-sand test pieces, in addition to compression strength tests.

Fig. 1 illustrates the machine (designed by W. Y. Buchanan) to which the author has fitted equipment for making both tensile and shear strength tests. Fig. 3 is a vertical hydraulic machine designed by the author for carrying out the same tests. The tensile test pieces can be seen in position in the jaws ready for pulling, whilst the shear heads for shearing the standard A.F.A. 2 in. dia. by 2 in. long test piece can be seen lying on the top of each apparatus ready to be fitted in position between the ram head and the end plate as soon as the tensile test has been carried out.

Both machines can be fitted with two or more pressure gauges having maximum fingers to indicate the load at which the tensile or shear test pieces break. The machine in Fig. 1 has pressure gauges reading up to 50 and 400 lbs. per sq. in., which, with a ram area of 10 sq. in., represents a total load of up to 500 and 4,000 lbs. respectively. Hydraulic oil pressure is a convenient and simple means of gradually applying the load and is, in the writer's opinion, to be preferred to any other method.

### Test Pieces

For compression and shear strength it has been found convenient to follow the Institute of British Foundrymen's Sands Sub-Committee recommendations to use for routine purposes the American Foundrymen's Association standard rammed test pieces. For tensile tests the test piece may be formed in the same mould used for forming test pieces for cement testing. This test piece is shown in the jaws in Figs. 1 and 3, and has a cross section of 1 sq. in. at the narrowest part. Hand ramming, however, does not give very regular results when the oil-sand mixture has much green bond strength.

In No. 1 oil-sand mixture containing clay-bond moulding sand and having a green bond strength 2.3 lbs. per sq. in., hand rammed tensile pieces, after baking, showed results varying from 65 to 80 lbs. per sq. in., whilst No. 3 mixture containing only 0.9 lb. per sq. in. green bond strength showed results which were much more uniform.

The A.F.A. standard ramming machine can now be fitted with an adapter to form a similar shaped tensile test piece (see Fig. 4) and recent tests show that this is the most expeditious and uniform method of making test pieces, especially those having much green bond strength.

### Baking Test Pieces

For routine purposes it is desirable to bake standard rammed test pieces in the actual core ovens used in the foundry in order to ascertain what properties the oil-sand cores used in the foundry are likely to have; but for experimental

* "Sands, Clays and Minerals," November, 1936, p. 65.

purposes to determine the best time and temperature for baking, also for comparing the properties of different brands of core oil, paste, dextrine, and other artificial bonds, it is desirable to carry out laboratory tests in a suitable oven in which the conditions of temperature, time, and air ventilation can be kept as uniform as possible.

A number of tests made recently by the writer showed the importance of proper air circulation within the oven. This will be appreciated when it is remembered that oil-sand cores harden, after baking, mainly due to the oxidation of a drying oil such as linseed oil, which forms a tough film as a result of absorbing from 16 to 20 per cent. of its weight of oxygen.

TABLE II.—*Relationship Between Various Mixtures of Oil-Sand Cores.*

| Test. | No. 1 Mixture. | No. 2 Mixture. | No. 3 Mixture. |
|---|---|---|---|
| Compression strength, lbs. per sq. in. .. .. | 107 | 425 | 117 |
| Shear strength, lbs. per sq. in. .. .. .. | 82 | 404 | 105 |
| Tensile strength, lbs. per sq. in. .. .. .. | 75 | 127 | 70 |
| $\frac{\text{Shear} \times 100}{\text{Compression}}$, per cent. .. | 77 | 95 | 90 |
| $\frac{\text{Tensile} \times 100}{\text{Compression}}$, per cent. .. | 70 | 30 | 60 |

In one oven fitted with hot air channels entering at the bottom at diagonally opposite corners, and in which the hot air was drawn out by a chimney 18 in. high, it was found that after

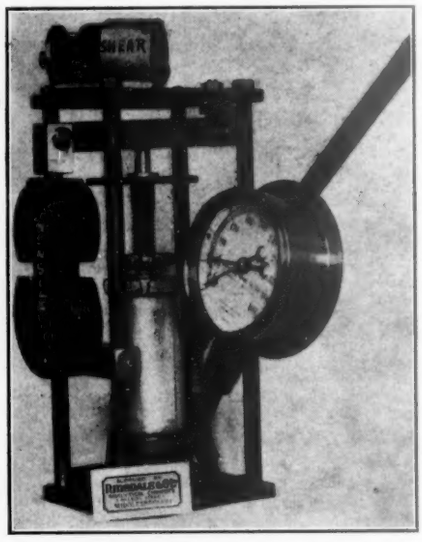



FIG. 3.—RIDSDALE'S DESIGN OF HYDRAULIC COMPRESSION STRENGTH TESTING MACHINE ADAPTED TO MAKE TENSILE AND SHEAR TESTS.

2 hours' baking at about 200 deg. C., A.F.A. test pieces showed a compression strength varying from 47 to 70 lbs. per sq. in., whereas test pieces made from the same oil-sand mixture and baked at the same temperature for the same time under conditions in which a continuous supply of air was forced into the oven under a slight pressure, the oxidation of the oil was much more complete, and the compression strength showed much more regular results of between 105 and 129 lbs. per sq in., viz., about twice as high as the former tests which indicated that oxidation was incomplete.

Fig. 2 shows an oven specially made to give an even temperature and air circulation. It is electrically heated and the temperature controlled by thermostat. It will be seen that there is both a large and a small fan fitted inside the door of the oven and electrically driven so as to produce efficient air circulation. An oven of this kind is much to be preferred to most of the ordinary laboratory ovens at present available in Great Britain.

### Comparison of Compression, Shear and Tensile Tests

Several tests have been made on three different oil-sand mixtures with the object of ascertaining whether there was any fixed relationship between the compression, shear, and tensile tests, but Table II shows that this does not seem to be the case—at any rate on the three different oil-sand mixtures previously referred to.

It will be seen that in different sands the shear strength varies from 77 to 95 per cent. of

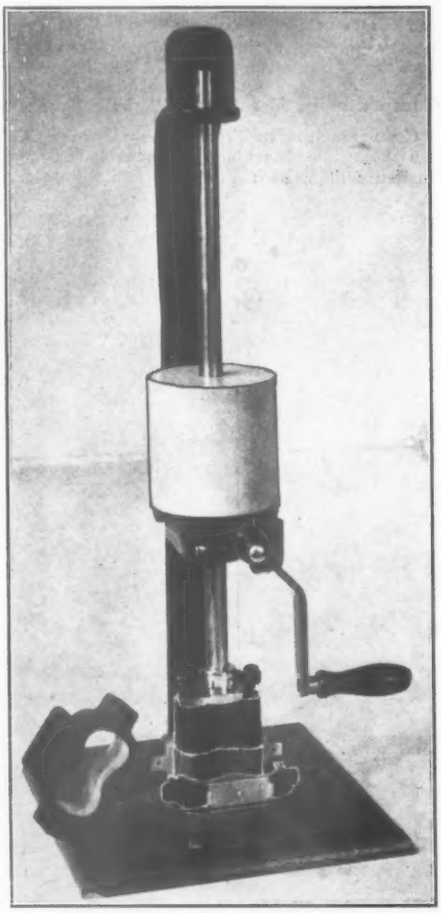


FIG. 4.—A.F.A. STANDARD DROP RAMMER FITTED WITH DIETERT'S DESIGN TENSILE TEST-PIECE RAMMER.

the compression strength, whilst the tensile strength varies from 30 to 70 per cent. of the compression strength. This indicates that on an unknown oil-sand mixture the compression strength and shear strength cannot be computed from the tensile strength, though it might be possible to find a definite relationship using varying quantities of the same core oil with the same sharp sand.

In conclusion, it might be stated that the testing of oil-sand mixtures gives information of considerable value to the practical foundryman, and now that machines manufactured in this country for the determination of compression strength can also be adapted to the determination of tensile strength and shear strength with standard ramming and efficient baking the problem is considerably simplified.

## The Annual Aachen Foundry Convention

The Giesserei Institut (Foundry Institute) of the Technische Hochschule, Aachen, have arranged a winter colloquium to be held on February 4 and 5 next. On the first day, the Papers to be read in the morning will be presented at a joint meeting of the Institut, and the materials committee of the Aluminium-Zentrale of Berlin, and will include the following:—"The Precipitation Hardening of Aluminium, with Special Reference to Cast Alloys," by Prof. Dr.-Ing. A. v. Zeerleder, of the Technische Hochschule of Neuhausen, Switzerland; "The Heat-Treatment of Silumin," by Dipl.-Ing. G. Guertler, Metallgesellschaft, Frankfurt am Main; "The Problem of Hardening $Mg_2Si$-containing Al-Mg Alloys," by Dr.-Ing. E. Kröner, I. G. Farbenindustrie, A.-G. Bitterfeld; "Recent Developments in Casting Bars and Ingots of Light Metals," by H. Röhrig, Lautawerk, Lausitz; "Quality Specifications as a Means for Standardising All Foundry Alloys," by Dr. R. Sterner-Rainer, Karl Schmidt G.m.b.H., Necharsulm; "Gases in Aluminium Castings," by Prof. Dr.-Ing. H. Nipper, of the Aachen Giesserei Institut. The proceedings will terminate with a discussion.

At the afternoon session, the following Papers will be presented:—"The 'Life' and Thermal Resistance of Metal Castings," by Dr. R. Genders, London; "Machining of Cast Materials (Cast Iron, Malleable Iron, Light Metals)," by Prof. Dr.-Ing. H. Opitz, Technische Hochschule, Aachen; "Interpretation of the Notched-Bar Test on Brittle Materials," by Dipl.-Ing. F. Uebel, Technische Hochschule, Aachen; "Shrinkage and Strains in Cast Iron," by Obering P. Tobias, Fa. Lanz A.-G., Mannheim; "Superable and Insuperable Difficulties in the Evaluation of Metals," by Dr. Max Werner, I. G. Farben A.-G., Leverkusen. These Papers will be followed by a discussion.

At the morning session of February 5 the following Papers will be presented:—"On the Primary Crystallisation of Cast Iron," by Dipl.-Ing. W. Patterson, Giesserei Institut, Aachen; "Scrap Melting in the Cupola Furnace," by Dipl.-Ing. K. Achenbach, Giesserei Institut, Aachen; "Review of the Researches Carried Out by the Giesserei Institut," by Prof. Dr.-Ing. E. Piwowarsky; "Problems of Organisation and Industrial Economy Relating to Foundries in the Light of the Four Years' Plan," by Dr.-Ing. Th. Geilenkirchen; and "A Phase of Industrial Co-operation," by Dr.-Ing. H. Stevens. In the evening a general discussion will be held, and an address by Prof. Dr.-Ing. e.h. K. Arnhold on "Leadership and Succession in the National-Socialist Organisation."

All meetings will be held in No. 51 lecture theatre of the Naumann Institutes of the Technische Hochschule, Aachen, Intzestrasse, 1. On Saturday, February 6, visits will be paid to textile and needle factories in Aachen and an excursion made to the Eifel. Visits to a number of foundries may be arranged.

## Book Review

**Stock Exchanges Ten-Year Record, No. 28.** (1936). Compiled and published by Fredk. C. Mathieson & Sons, 16, Copthall Avenue, London, E.C.2. Price 20s. 6d. post free.

Now that the foundry industry is making profits there will be—and we have noticed it—a revival of interests in stocks and shares. We know of no better medium for getting a proper perspective of an investment than by delving amongst the 7,000 securities listed and seeing the variations in market prices which have taken place during the last ten years. In addition all dividends—if any—are listed. A rather striking omission is General Refractories Limited.

V. C. F.

ADVERTISING PAGES REMOVED



# Some Detrimental Factors Affecting Steel Castings*

By E. J. BROWN

### Non-Metallic Inclusions

The result of any deoxidation process leads to the formation of various complex and undesirable products known as inclusions, generally, either of silicates or oxides. In addition, there are sulphides, the migratory habits of which are fairly well known, and which are easy to detect by means of sulphur prints. The silicates may be of widely fluctuating composition, fusion temperature and size according to a number of influences. They are of a ternary nature, being oxides of iron, silicon and manganese. It has been mentioned that these inclusions, being reaction products, vary in size, the term being, of course, purely relative. The dimensions may vary from almost sub-microscopical dimensions, as sometimes occurs in the case of alumina, to as large as $\frac{1}{8}$ in. in exceptional cases. It is obvious that, by reason of the very existence of these inclusions, certain weaknesses must result. As far as steel castings are concerned, however, their most detrimental position is in the primary grain boundaries to which they migrate, with consequent weakening effect.

Various workers have made a study of the properties of the various inclusion compositions,

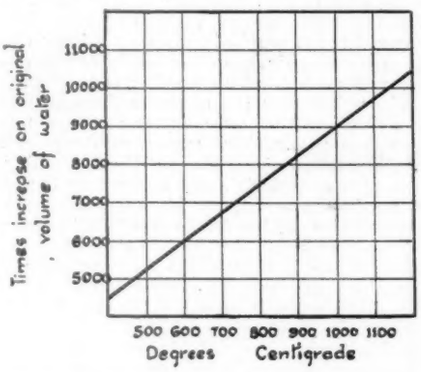



FIG. 1.—EXPANSION OF WATER VAPOUR WITH INCREASING TEMPERATURE.

taking into account their property to coalesce with consequent increased rising velocity through the bath. It is probable that slag resulting from furnace or ladle wear, due to its comparatively large size, will almost immediately rise to the surface of the slag. In other words, the larger the size the greater the probability of rising into the slag, and in this respect it is found that the best results are obtained using a silico-manganese deoxidant in the ratio of five parts of manganese to one of silicon. The inclusions so formed are completely molten at about 1,200 deg. C. and would be encouraged to coalesce and rise through the bath.

A very important point regarding the reaction between a deoxidiser and iron oxide should be mentioned. In common with most chemical reactions, few metallurgical reactions go on to completion, that is equilibrium conditions are never reached. One reason in particular is that with a ladle of steel there is insufficient time; in addition, certain laws of mass action and other problematical matters interfere. However, the result is that the reaction might cease when there is five to fifty times as much ferro-oxide in solution as would be possible were equilibrium conditions attained. Thus it should be borne in mind that there is invariably some oxide of iron remaining in solution.

Whilst inclusions in steel are the outcome of furnace reactions, there is another and probably more important type as far as the foundry is concerned. Reference is made to the wear of refractories and sands causing mechanically trapped material. Steel poured overlip is particularly prone to this, due to the erosion of the lip material. It follows that a loosely rammed mould which will not withstand the wash of the liquid steel is a potential danger.

### Gas Inclusion Shops

It was mentioned that the question of gases, although closely allied to the problem of solid inclusions in steel, would be dealt with separately. The gases in steel which concern the steelmaker are oxygen, carbon monoxide, carbon dioxide, hydrogen and nitrogen. It is doubtful whether oxygen exists in the elemental state. Hydrogen and nitrogen occur in the form of hydrides and nitrides respectively. Each of the five gases mentioned is capable of causing blowholes in steel, the responsibility for their existence as a factor being that of the steelmaker.

The most important reaction which results in the evolution of gas is that between iron oxide and carbon, the resulting gases being carbon monoxide and carbon dioxide, which are largely found among those gases generated at freezing temperature of the metal. It is well known that, under certain conditions, it is impossible to kill or settle steel no matter what amount of deoxidiser is used, the reason being that the capacity of the steel to hold gases has been exceeded and they are evolved as temperature falls.

The action of hydrogen, apparently, is not so well known. It is claimed that the reaction between iron oxide and hydrogen is reversible. Deoxidisers are credited with the ability to increase hydrogen solubility, but their effect may be due to their influence on the oxygen content.

There appears to be very little doubt of the solubility of nitrogen; the nitride formed is fairly stable and not easily decomposed. Bessemer steels are apt to contain the greatest amount, and crucible steels are said to contain the least. There is evidence which suggests that silicon is a contributory means of introduction. There is no apparent reason for the foundryman to interest himself in nitrogen as a source of blowholes, but rather with the two particular gaseous influences previously mentioned, namely, carbon monoxide and those attributable to hydrogen. The question of hydrogen in steel has received a fair amount of attention recently, following the discovery that this gas is responsible for the formation of so-called "snowflakes" or internal fissures, found largely in forgings and the like. In this connection, experiments relating to a close control of the humidity of the atmosphere during steel-making operations promises some interesting results.

### Mould Gases

Only a very brief outline has of necessity been given of two of the physical weaknesses of cast steel. One attendant risk is that the moulder may consider himself absolved from all responsibility of porous castings or any other faults which may occur. There is a class of blowhole which may be directly attributable to sand, or to the inability of generated gases to escape, such gases penetrating the molten steel within the mould.

Full appreciation is, perhaps, not always given to the large volumes of gases which may be generated by the decomposition of combined water in clay. An examination of Fig. 1 will show that if, at 1,200 deg. C., the generated gases were allowed free expansion, the volume occupied would be about ten thousand times that of the original volume of water. These large volumes due to increasing temperature require ample room for expansion and escape.

There is a further cause of the formation of blowholes, for which dual responsibility must be taken by both the steelmaker and the moulder. Most workers have experienced a heat of steel which will settle perfectly in a chill mould, but which shows signs of unsoundness in green sand. Under such circumstances it is conceivable that the reason is due to the gas solubility being disturbed because of the generated gases from the mould. It is logical to regard gases in steel as being in a state of supersaturation, thus being readily relieved.

In spite of the potential weakness to which cast steel is heir, it will be generally agreed that, with a properly located and well fed test-bar, there is no difficulty in meeting existing specifications. This applies in particular to electric furnace steel, which is more or less unfailing. The steel founder should always ask himself whether the test-bar is a true index of the whole of the casting, or whether it is not a

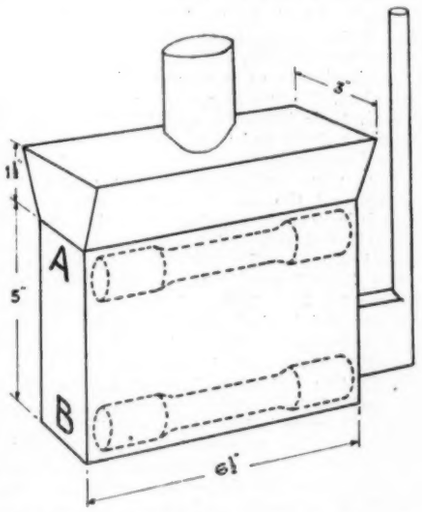



FIG. 2.—THE TEST BAR "A" GAVE 31 TONS TENSILE, ASSOCIATED WITH A 22 PER CENT. ELONGATION, WHILST TEST BAR "B" GAVE 31.9 TONS TENSILE AND 29 PER CENT. ELONGATION.

value obtained from just a portion cast under more or less ideal conditions.

Fig. 2 demonstrates an example of two tests taken from different positions of an extravagantly large test-bar. The tensile test-bar at A was perfectly fed, but the ductility is decidedly inferior to that taken from the lower position. The author does not propose to be definite regarding the actual reason for the difference, but suggests that, apart from the effect of ferrostatic pressure, either gases or inclusions are responsible for the lower ductility. The only way of elucidating such difficulties is by a critical examination of the probable causes as outlined.

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LEY'S FOUNDRIES & ENGINEERING, LIMITED, has been registered as a public company with an authorised share capital of £1,000,000. This new company is to acquire 90 per cent. of the share capitals of Ley's Malleable Castings Company, Limited, and the Ewart Chainbelt Company, Limited, both of which carry on business at Derby, and to carry on a foundry and engineering business.

* An Entry for a Short Paper Competition organised by the Sheffield Branch of the Institute of British Foundrymen.

# Foundry Selling Practice

## FINDING THE BUYER'S WEAKNESS

### By ERIC N. SIMONS

Although it is commonly assumed that the foundry salesman, after he has had a few years at his job, loses all nervousness, and visits a new customer with as much assurance as an old one, this is not quite true, and many foundry salesmen are always nervous when visiting a firm which they have never before approached. It is this, often enough, which makes them reluctant to call on new people, so long as they can maintain a good turnover from their existing connections. A new firm is an unknown quantity to them, and without consciously realising why, they defer the first call.

However hardened to rebuffs the salesman may be, he is never quite certain that his behaviour under what may be a really gruelling fire of criticism from a stranger will pave the way to success, and the potential buyer may easily discover the weak spots in his temper or personality.

#### Approaching New Firms

Furthermore, approaching new firms is hard spadework, and the easier a salesman finds it to get business from his established clientèle, the less inclined he is for the labour of breaking new soil. This, again, conduces to nervousness of the unknown buyer. Nevertheless, nervousness is a stimulus to some men, making them tense and alert. They call up their powers of self-control, their ingenuity and talent, to face the test successfully and regain their self-confidence.

The foundry representative who is not slightly nervous when calling on a new customer is, perhaps, all the less likely to succeed. His mind is less concentrated on the main issue. He is so self-confident, and so used to one particular method of approach, that he brings his guns into action immediately, without first ascertaining that he has loaded with the right ammunition. He may end by irritating the buyer, in losing his own temper, or in creating a bad impression that may take a long time to efface.

While this fact of preliminary nervousness on the part of the foundry salesman when calling on a new buyer is important, equally important is the fact that buyers themselves are subject to a rather similar nervousness when called on by a salesman they do not know. Why is this? Primarily, a foundry salesman's job is not to force the buyer to give him an order, but to make him *feel the desire to place an order* with him, which is a very different thing.

#### Changing Suppliers

The intelligent buyer knows a good casting and a good argument when he meets them. But he knows many things the salesman does not, and cannot. He knows, for example, that his firm is not doing too well, and that his directors have told him to keep his stock low, or to buy at the lowest price, irrespective of the firm. He knows, perhaps, that the man who is selling his firm's castings at the moment is a personal friend of the chairman, or is a large shareholder, or is on the board, and that he dare not change the source of supply. He knows, perhaps, that the works manager thinks he ought to order the castings himself, and will delight in the ability to make trouble if a change of suppliers turns out badly. He knows that the chief accountant has proved that to open new accounts costs money, and that he, the buyer, has therefore been told to reduce the number of firms from whom he orders, wherever this is possible, in order to save ledger work. He also knows that the salesman's task is to convince him that he ought to buy the brand of castings put before him. And often, although he may feel he ought to buy such castings, he cannot, for one reason or another.

Naturally, this is not a position he enjoys. Though he may be convinced the salesman is offering him good material, he must firmly refuse to buy. The salesman will think him unintelligent, which hurts his vanity, or powerless which hurts it still more. The salesmen he sees regularly understand his position, or can be told in friendly fashion. They know how to retire tactfully and wait their time. The new man, he thinks, will probably be a pushful, energetic fellow who will not readily take "no" for an answer. Hence the buyer is reluctant to see him, and is faintly nervous of the interview he may feel bound to grant.

#### A Typical Case

If the foundry salesman appreciates this equivalent nervousness of the buyer, it will help him. An illustration will serve to prove this. A certain firm had decided to change its source of supply for castings. The orders were so big, and the connection between this firm and the foundry that had hitherto supplied its requirements so well-established, that the buyer knew the foundry salesman would soon be visiting him to know where the orders had gone. He himself was not too sure that the change was for the better, and he felt he could not honourably refuse to see the representative, although he dreaded the interview.

The foundry salesman arrived, and at first fought extremely hard; but he had not noticed the buyer's nervousness. He made out a fine case for his castings, a case the buyer could not disprove, though he would have liked to do so. Then, instead of going on to the one last argument which, with the buyer's state of mind such as it was, might have reopened the whole issue, he made an error. He proposed that if the buyer was determined to try the other competing foundry, he should at least share his orders between the two foundries. That lost him the day.

Discussing the matter with the writer afterwards, this buyer said: "If that man had only known how near he was to getting the business back, he'd never have offered a compromise. I was feeling all the time that I was doing a rather mean thing, and not at all sure I was justified in taking the risk, and then he made me lose that feeling and become the hard-faced business man again." In short, the foundry representative had failed to detect the buyer's weak spot.

#### Signs of Weakness

How is he to detect it? There are signs and symptoms. The roaring, raging buyer is often a nervous man hiding his fear of being persuaded by pretending belligerence. The man who continually refuses to see a salesman is nervous, in many instances. There is usually some reason for this nervousness, and the clever representative will rack his brains to find it. If he succeeds, he has a magnificent spear-point for his attack.

As a rule, the actual grounds for a buyer's nervousness are the very things that make it possible to get an order from him. Thus, some buyers never like to see salesmen they do not know, when they are actually in the market for the product these salesmen are selling. This may sound paradoxical or narrow, but there are sound reasons. The buyer has one or two regular suppliers of castings, whom he knows and trusts, and he sends them his inquiries as a matter of course. If another foundry's representative calls when such an inquiry is being drawn up, he cannot easily lie if asked whether he is in the market for these castings (assuming he is an honourable man). Nor, if the foundry be a reputable one, and the salesman personable, can he bluntly decline to furnish particulars of his requirements. If he does so, he feels he is giving the unknown foundry an advantage over his regular suppliers, who will receive the inquiry by post. The new salesman may ask questions designed to eliminate doubtful points from the inquiry, thereby gaining from the personal contact.

If his quotation be advantageous, it means taking work from old friends, and will necessitate changing patterns over, and the like. His reasons for disliking to see new salesmen may be psychological and trivial, but they exist, and the salesman who knows or divines them has a powerful weapon.

Again, the buyer is often nervous because he has a weak spot he fears the salesman may discover. One buyer, for instance, known to the writer, can never resist the offer of a trial sample or casting. He knows his weakness, and dreads that a salesman will act upon it. Having accepted a casting or sample, which proves reasonably satisfactory, he feels a moral obligation upon him to place at least one order with the firm that supplied it.

#### A Repercussion

Every buyer has some little weakness of this sort, which makes him nervous of the new salesman, and which the salesman himself must try his hardest to ascertain. Some buyers, for example, are hypnotised by cheapness, and will look only at the price in a quotation. Others are influenced by novelty, and will order anything that is new, especially if they think that Jones across the way, the competing firm's buyer, has not bought it or does not know about it. Others, again, are attracted by castings that are well packed, where packing is feasible.

The writer once lost an order through failing to appreciate that some buyers are exceedingly suspicious (not without reason, as the practices of the steel swindlers show). He was selling a new type of material, and to simplify the task of purchasing a trial set, his firm had prepared a detachable trial order form which formed an integral part of the booklet describing these goods. He had succeeded in convincing the buyer of the product's advantages, and the buyer had verbally agreed to order a trial lot. The writer, thinking to clinch the matter, and for his firm's sake and the sake of ordinary business regularity, asked the buyer to complete, sign and detach the trial order form. The buyer at once drew into his shell, haggled, and said that on second thoughts he thought he would wait and have a word with his foreman about it, although the book could be left. Further argument merely made things worse. And no order resulted.

It appeared, eventually, that this man had been victimised by a firm of swindlers who persuaded a buyer to sign one of their trial order forms, and then sent in to him far more material (often of worthless character) than he had actually ordered. If the writer had realised this, he would have set to work to remove the suspicion that he was another of the same fraternity, instead of, as he mistakenly did, trying the same arguments again, in the belief that the buyer was not fully convinced about the goods.

There is a weak spot in every buyer, and an experienced salesman should not take long to find it out, and play his cards accordingly.

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#### "Romos"—A Rust Preventive

In a circular letter which came into our hands sent out by M. R. Chemical Products, Limited, of 22, Basinghall Street, London, E.C.2, the theory is put forward that rust spots on enamelled iron and steel are due to the decomposition of iron-manganese sulphides. The nature of the reaction is said to be altered by the inclusion of this proprietary salt "Romos," which is stated to be preferable to plain borax or sodium phosphate because of the modifications of the chemical reactions involved.

ADVERTISING PAGES REMOVED



# This Week's News in Brief

## Trade Talk

OVER ONE HUNDRED AND SIXTY "Speedy" Moisture Testers have been sold in the U.S.A.

TEN HOUSES AND BUNGALOWS of the most modern types will be erected at the forthcoming Ideal Home Exhibition.

THE DIRECTORS of the International Combustion, Limited, Derby, announce that the value of the work in hand exceeds £1,500,000.

JOHN READHEAD & SONS, LIMITED, South Shields, have received an order from London owners for a 9,000-ton steamer. The firm will also supply the engines.

WORKERS IN THE CLYDEBANK factory of the Singer Manufacturing Company, Limited, are working overtime on an order for 25,000 sewing machines for the Far East.

ROLLS-ROYCE, LIMITED, have bought Duffield Bank House, a Georgian residence at Duffield, near Derby, for use as a guest house for directors and visitors to the Derby works.

THE NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, Hydepark Works, Glasgow, are to supply 18 coal- and eight oil-fired locomotives for the Egyptian State Railways.

JOHN BOWES & PARTNERS, LIMITED'S coke and coal by-product plant, now being built at Hebburn-on-Tyne, at a reported cost of nearly £250,000, is expected to be operative in April.

ABOUT SEVEN HUNDRED AND TWENTY children of employees at the Stanton Ironworks Company, Limited, were entertained at a New Year party given by Mr. E. J. FOX, managing director.

HONEYWELL-BROWN, LIMITED, 70, St. Thomas Street, London, S.E.1, has been established as a factory branch of the Minneapolis-Honeywell Regulator Company and the Brown Instrument Company.

ANOTHER BLAST FURNACE is to be put into operation at Skinningrove by Dorman, Long & Company, Limited. This will bring the number of furnaces working in the North-East area to 32, compared with 26 a year ago.

COLBOND, of 6, Harriet Walk, London, S.W.1, have made arrangements through Keighley Laboratories to accord to new users of Colbond a free technical service during the initial stages of its introduction.

THOMAS E. GRAY & COMPANY, LIMITED, London, have received a repeat order from John Lysaght, Limited, for the building, at their Wolverhampton works, of a second drying stove under the "British Herrmann" system. Other contracts in hand include one from Hayward Tyler & Company, Limited, Luton, for the erection of a new core stove, and the conversion of the existing mould stoves, together with another from John Summers & Sons, Limited, Shotton, for their ninth installation of the "British Herrmann" system.

WHEN THINKING OF
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THINK OF
RICHARDSON'S
Established 1887.
We Supply Re-Conditioned & New
SAND BLAST PLANTS
AND
AIR COMPRESSORS.
Tilghman's, Room, Barrel, Chamber, Rotary Table, Dust Arrester, and Continuous Feed Barrel Plants.
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Grams: "SANDBLAST, B'HAM."
R. J. RICHARDSON & SONS, Ltd.,
Commercial Street, Birmingham.

## Obituary

MR. ROBERT D. BELL, for many years foreman grinder to the Falkirk Iron Company, died at Falkirk recently.

MR. J. F. GILLOTT, formerly manager and consulting engineer to the Butterley Company, Limited, died on January 4.

MR. HAROLD A. ENTWISLE, formerly a director of Entwisle & Gass, Limited, of the Atlas Foundry, Bolton, died recently, aged 73.

MR. JOHN HILL, works accountant and office manager at the Redcar works of Dorman, Long & Company, Limited, Middlesbrough, has died.

THE OLDEST EMPLOYEE at the Newmains works of the Coltness Iron Company, Limited, Mr. James Cameron, died on January 11, at the age of 78. About a year ago he received a presentation from the company in recognition of 66½ years' service with the firm.

MR. HUGH M. HODGART, who died at Meikleriggs, Paisley, on January 9, was a director of Fullerton, Hodgart & Barclay, Limited, engineers and iron-founders, of Vulcan Works, Paisley, and a governor of the Paisley Technical College. He was also a Past-President of the Scottish Branch of the Institute of British Foundrymen.

THE DEATH HAS OCCURRED of Mr. F. E. L. Walker, J.P., the proprietor of Isaac & Israel Walker, Limited, of Effingham Mills, Rotherham. Only three weeks ago we published a full biography of the deceased gentleman, who was 61 years of age, on the occasion of his elevation to the Bench, and we would ask his friends to refer to this.

WITH THE DEATH OF Prof. Dr. Aulich, which occurred on January 13, Germany, and indeed the whole foundry industry, has lost one of its foremost scientific investigators. Whilst he achieved prominence as a research worker into the properties of foundry sands, he was also well known and appreciated as a pure metallurgist, being specially interested in cast products.

MR. RICHARD CHARLES BAKER, who founded Borax Consolidated, Limited, died on January 12, in his 80th year. Mr. Baker first formed in 1896 a company in London known as the Pacific Borax and Redwood Chemical Works, in which British and American interests were united. Three years later the present company came into existence, with Mr. Baker as its managing director, in which capacity he had acted ever since.

WE SINCERELY REGRET to announce the death of Mr. Thomas Pollock MacNab, the proprietor of MacNab & Company, the makers of Tabor moulding machines and other foundry plant, of 150, Holborn, London, E.C.1. He has died in Germany after a long illness. The last time we saw Mr. MacNab was in a bank at Düsseldorf, at the period of the International Congress, when he was apparently fit and well and enthusiastic about conditions in the industry. Mr. MacNab never returned to England, but went on to Wiesbaden, where his condition gradually deteriorated, and where death ultimately supervened. Apart from his interest in foundry machinery, Mr. MacNab was well known in engineering circles, having several important inventions attached to his name. He was in his 60th year.

## Contracts Open

**Chanctonbury,** January 23.—Spun-iron pipes and specials, for the Rural District Council. The Water Engineer, Council Offices, Storrington, Pulborough.

**Dewsbury,** January 23.—Cast-iron pipes and specials, steel tubes, etc., for the Town Council. The Gas Engineer, Gasworks, Savile Town, Dewsbury.

**Horsham,** January 27.—Spun-iron pipes and specials, for the Rural District Council. The Water Engineer, Storrington, Pulborough.

**Johannesburg,** February 22.—300 short tons of pig-iron, cold blast; 800 tons of hematite No. 1, for iron foundry; 1,500 tons of hematite No. 1, for steel foundry; 25 tons of ferro-manganese, 78/80 per cent., for the South African Railways and Harbours Administration. The Department of Overseas Trade. (Reference T. 31,080.)

**Stockport,** January 23.—Iron castings, for the Town Council. Mr. W. F. Gardner, borough surveyor, Town Hall, Stockport.

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Telephone: Temple Bar 3951 (5 lines).

## Personal

MR. JAMES FORGHAM, a sand mixer in the foundry of Wootton Bros., Limited, Coalville, has retired after nearly 53 years' service with the firm.

THE GRAND COUNCIL of the Federation of British Industries has unanimously approved the nomination of Lord Hirst for the office of President of the F.B.I. for the coming year, which commences in April.

MR. R. HAMILTON, manager of the Oldside works of the Workington Iron and Steel Branch of the United Steel Companies, has retired after 62 years with the firm. Mr. Hamilton was the first man to make ferro-manganese in Cumberland or to make successfully West Coast acid-Bessemer pig-iron.

MR. W. R. MACDONALD was appointed chairman of the Scottish Branch of the Institution of Mechanical Engineers at a meeting in Glasgow on January 14. He is a director of D. J. MacDonald, Limited, South St. Rocque's Works, Dundee, and has been a member of the Institution for 30 years.

A RECENT MESSAGE from Johannesburg announces the personnel of the newly formed committee to control the South African Branch of the Institute of British Foundrymen to be as follows:—Branch-President, Mr. T. Nimmo Dewar, managing director of the Union Steel Corporation; members of Council: Mr. P. M. Boag, managing director of Wright, Boag & Company; Mr. J. A. Durie, general manager of Rowe Jewell & Company; Mr. A. H. Guy, managing director of Eclipse Tube Mill Liners, Limited; Mr. J. N. Mackenzie, chairman of Wright, Boag & Company; Mr. D. Davidson, managing director of the East Rand Engineering Company, Limited; and Mr. A. H. Moore, managing director of the Standard Iron, Steel & Brass Foundries, Limited.

### Wills

LACE, RICHARD, managing director of English Tools, Limited ... ... £2,780

RUTHERFORD, WALTER, chairman of the Metropolitan Construction Company, Limited, London, one of the founders of the British Electrical & Allied Manufacturers' Association ... ... £13,879

## Forthcoming Events

JANUARY 29.

*Institute of Metals (Birmingham Section)*:—"Special Cast Irons," Paper by J. G. Pearce, M.Sc., at the James Watt Memorial Institute, Birmingham, at 7 p.m.

**Institute of British Foundrymen**

JANUARY 26.

*Scottish Branch*:—Joint meeting with the Institution of Engineers and Shipbuilders in Scotland. "Cast Iron and its Application to Engineering," Paper by A. Campion, F.I.C., at the Institution of Engineers and Shipbuilders, Elmsbank Crescent, Glasgow, at 7.30 p.m.

JANUARY 30.

*Wales and Monmouth Branch*:—"Moulding Castings for Vertical Pump Motors," Paper by T. W. Trayherne, at the Merchant Venturers' Technical College, Bristol, at 6.30 p.m.

FEBRUARY 1.

*Falkirk Section*:—Joint meeting with The Institute of Vitreous Enamellers. "Sands and Facings with reference to Light Castings for Enamelling," Paper by H. McNair, at the Temperance Café, Lint Riggs, Falkirk, at 7.15 p.m.

FEBRUARY 3.

*London Branch*:—"Steel Castings," Paper by J. Deschamps, at the Charing Cross Hotel, London, W.C.2, at 8 p.m.

FEBRUARY 4.

*East Anglian Section*:—"Some Considerations of Cupola Operation," Paper by H. H. Shepherd, at the Lecture Hall, Central Library, Ipswich, at 7.30 p.m.

*Sheffield Branch*:—"The Heat-Treatment of Castings," Paper by Dr. R. Hunter, at the King's Head Hotel, Change Alley, Sheffield, at 7.30 p.m.

# Raw Material Markets

Supplies of pig-iron have become a little less stringent, and a few small parcels have been released for export purposes. Nevertheless, the pressure for deliveries from home consumers is still insistent. All descriptions of steel are being fully taken up under existing contracts.

## Pig-Iron

**MIDDLESBROUGH.**—Heavy deliveries of pig-iron continue to be made, and a few small export inquiries have been met. Supplies still have to be carefully distributed, but, with the starting up shortly of another blast furnace at Skinningrove, additional iron should soon be forthcoming. Prices for home trade are 81s. per ton for No. 3 Cleveland G.M.B. delivered in the Middlesbrough district, 83s. elsewhere on the North-East Coast, 84s. in Falkirk, and 87s. in Glasgow.

Activity in the market for hematite pig-iron is unabated. Orders are being received on an increasing scale, and outputs in many cases have been disposed of over the first half of the year. Delivery arrears have been reduced to some extent, while a few small parcels have been despatched abroad. For export, 87s. 6d. per ton is named as an approximate price for East Coast mixed numbers, f.o.b. For home trade, prices are 97s. 6d. per ton delivered on the North-East Coast, 103s. in Sheffield, and 108s. 6d. in Birmingham.

**LANCASHIRE.**—Only a comparatively small amount of new business has been transacted recently, but there is a steady call for supplies against contracts. A few replacements have been made. Jobbing foundries are active, as, also, are the machine-tool makers, the light-castings manufacturers, the heavy electrical branch and many of the special engineers. Offers of Staffordshire and Derbyshire brands of No. 3 foundry iron for delivery to users in the Lancashire price zone are all on the basis of 89s. per ton, with Northants at 87s. 6d. and Derbyshire forge iron at from 84s. to 86s., according to the class of consumer. West Coast hematite is quoted at 106s., and East Coast at 105s. 6d., both subject to a rebate of 5s. per ton and delivered equal to Manchester. Scottish iron is quoted around 105s. per ton for delivery in the Manchester area. Supplies of all grades of hematite are scarce and values are firm.

**MIDLANDS.**—The call for Northamptonshire pig-iron, in particular, is very heavy, and supplies are by no means plentiful, many users being compelled to accept other grades. No. 3 foundry iron is at 83s. 6d. for Northants and 86s. for Derbyshire, Lincolnshire and North Staffordshire iron, delivered to Birmingham and Black Country stations, and subject to a small sliding-scale rebate for large consumers. An extra 11d. per ton is charged for delivery into works. Supplies of Derbyshire iron are more easily obtainable, but, even so, stocks are having to be drawn upon. Jobbing foundries and the general engineers are very well employed, and are taking up heavy tonnages of special-grade irons. Refined iron is quoted at from £6 5s. to £7 15s., medium-phosphorus from 90s. to 95s., Scottish No. 3 at 107s. 6d., and other low-phosphorus iron from 97s. 6d. to 107s. 6d., delivered the Midlands. Demand for hematite remains well in excess of the current production. The Association prices are £5 9s. 6d. for West Coast mixed numbers, £5 8s. 6d. for East Coast No. 3, and £5 8s. for Welsh mixed numbers. An extra of 1s. 6d. per ton is charged for delivery into Midland works.

**SCOTLAND.**—The pressure for deliveries of pig-iron remains unabated. The official minimum price of 88s. f.o.t. furnaces for No. 3 foundry is still quoted, with No. 1 at 90s. 6d. Cleveland No. 3 iron is at 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow. Northamptonshire No. 3 foundry iron is 1s. 3d. per per ton less than the foregoing figures. There is a steady inquiry for hematite, and mixed numbers are quoted at 98s., less 5s. rebate, with basic, British and Indian, at 82s. 6d., less 5s. rebate, delivered steelworks.

## Coke

The foundry-coke market is very firm. Deliveries in many cases are far behind schedule. Prices are generally expected to be further increased. For delivery in Birmingham and district, best Durham coke is quoted at from 42s. 6d. to 45s., and Welsh coke from 39s. 6d. up to 54s. per ton.

## Steel

The production of steel in this country is maintained at a record level, but the market is less active owing to the comparatively small tonnage of material available for near delivery, states the official report of the London Iron and Steel Exchange. The insatiable home demand leaves only a small proportion available for export. Production on the Continent is not sufficient to meet the requirements of oversea markets, and buyers abroad are becoming uneasy regarding their future supplies and are anxious to place orders. The situation in the semi-finished steel department is still difficult, and, although the British works are operating at capacity, output falls short of consumers' needs. It is expected that additional plant will be brought into production during this month, but this can scarcely be sufficient to make up the deficiency between demand and supply. In the finished steel market heavy quantities are passing into consumption, but there seems to be no slackening in the market requirements. The steelworks are concentrating more upon maintaining deliveries than upon seeking fresh business, but, nevertheless, a heavy tonnage of orders is circulating in the market.

## Scrap

It is becoming increasingly difficult to obtain supplies of scrap on the Cleveland market. Heavy steel scrap at 62s. 6d. per ton is active, while machinery metal at 70s. is also well taken up. Clean light cast iron is now quoted at 57s. 6d., but supplies are short. Prices are already firm on the Midland market, but sellers usually require still higher levels before they are willing to enter into further sales. As a result, the market is quiet. Heavy steel and mixed heavy iron and steel in furnace sizes is at 55s. to 57s. 6d. per ton. Light cast-iron scrap is also at 55s. to 57s. 6d., and heavy wrought iron at 70s. Short, heavy steel, suitable for use in the foundries, is at 70s. per ton, delivered works. Prices are also inclined in an upward direction on the Lancashire market. Good-quality machinery metal is at up to 72s. 6d. per ton for delivery to Lancashire foundries, with good heavy wrought-iron scrap at 70s. Heavy melting steel is quoted around 60s. Deliveries on the Scottish market are heavy, but the demand remains above the present supply. First-quality heavy steel scrap is at 62s. 6d. for good parcels, while 60s. to 61s. 3d. is offered for smaller lots. Wrought-iron piling scrap is firm at about 72s. 6d., with 5s. more for lots of special quality. Heavy machinery cast-iron scrap, in pieces not exceeding 1 cwt., is 73s. 6d. to 74s. 6d., with ordinary cast iron, to the same specification, around 68s. 6d. per ton, delivered f.o.t. consumers' works.

## Metals

**Copper.**—All restriction of copper production has now been removed temporarily. Members of the restriction scheme have agreed on conditions under which curtailment would again become operative if necessary. The immediate effect on production will be negligible, as it is generally believed that producers are not in the position quickly to increase their rate of output. Following this announcement there was some decline in business with consumers, but consumption has been well maintained. It is uncertain, as yet, just what amount and what kind of influence will be exerted on the market as a result of the restriction decision. It would appear that still more speculation may be expected. The needs of the genuine buyer will be seriously jeopardised if the speculation is allowed to rule the market. The price of the metal is high, and has been well over the £50 mark recently, and a renewal of speculative buying may force the quotation to an even higher and more unnatural level. The domestic price in the United States is now 13 cents per lb. The labour position in that country, while a little improved, is still disturbed.

Daily market prices :—

*Cash.*—Thursday, £53 5s. to £53 6s. 3d.; Friday, £52 17s. 6d. to £53; Monday, £52 6s. 3d. to £52 7s. 6d.; Tuesday, £50 6s. 3d. to £50 8s. 9d.; Wednesday, £51 8s. 9d. to £51 10s.

*Three Months.*—Thursday, £53 6s. 3d. to £53 7s. 6d.; Friday, £52 17s. 6d. to £53; Monday, £52 7s. 6d. to £52 8s. 9d.; Tuesday, £50 8s. 9d. to £50 10s.; Wednesday, £51 10s. to £51 11s. 3d.

**Tin.**—New buying remains at a low ebb, and the market bears a somewhat neglected appearance. Consumption is reported to be maintained, but consumers generally are keeping out of the market until the effects of the 100 per cent. quota are more apparent. Continental interest is quiet, while business in the United States continues to be restricted by the strikes at many consuming plants. Some 200,000 workers are involved. Apart from this unfortunate factor, the tinplate mills are operating almost to capacity, and the industrial outlook generally is excellent.

Metal Exchange quotations were as follow :—

*Cash.*—Thursday, £231 5s. to £231 10s.; Friday, £232 5s. to £232 10s.; Monday, £231 15s. to £232; Tuesday, £229 10s. to £229 15s.; Wednesday, £229 10s. to £229 15s.

*Three Months.*—Thursday, £232 5s. to £232 10s.; Friday, £233 to £233 5s.; Monday, £232 10s. to £232 15s.; Tuesday, £230 to £230 10s.; Wednesday, £230 to £230 5s.

**Spelter.**—There is a heavy inquiry for this metal at the present time, and the market displays quite a firm tone. The price has increased considerably recently, but the real value of spelter is well in excess of the current figure. The quotation in the United States has been raised to 6 cents per lb., East St. Louis. The demand for brass and zinc die-cast products, which are used extensively in the motor-car industry, has fallen away owing to the labour troubles.

Official quotations were as follow :—

*Ordinary.*—Thursday, £22 12s. 6d.; Friday, £22 11s. 3d.; Monday, £21 13s. 9d.; Tuesday, £20 5s.; Wednesday, £21 5s.

**Lead.**—The problem to be faced in this market is the question of supplies, which are still very scarce. Production is steadily increasing, but the time when it overtakes consumption seems to be a long way ahead. The outlook is quite satisfactory, although the requirements of the building industry are expected to show a decline from the past year's heavy consumption. The statistical position of the market remains strong.

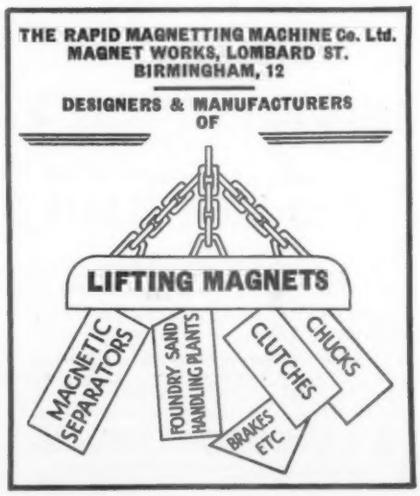
Day-to-day quotations :—

*Soft Foreign (Prompt).*—Thursday, £28 2s. 6d.; Friday, £27 13s. 9d.; Monday, £27 3s. 9d.; Tuesday, £26 11s. 3d.; Wednesday, £27 6s. 3d.

## New Company

*(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)*

**Ley's Foundries & Engineering, Limited,** Colombo Street, Derby.—Capital, £1,000,000 in 450,000 preference shares of £1 and 2,200,000 ordinary shares of 5s., to acquire 90 per cent. of the issued share capital of Ley's Malleable Castings Company, Limited, and Ewart Chainbelt Company, Limited, etc. Directors: Sir Henry G. Ley, Bt., F. D. Ley, E. N. Wood, and W. H. Atherton.



We cordially invite you to

# PAY A VISIT TO OUR STAND

at the

**A few of the PRODUCTS to be EXHIBITED :—**

**SAXPYRE**
**DIAZITE**
**SUPERMAG**
**INSULITE**
**SINTEX**
**DURAX**
**and**
**SANDS**
**of all types**

**There will be SPECIAL DISPLAYS for :—**

**BASIC REFRACTORIES**

**INSULATION MATERIALS**

**FIREBRICKS**

**PLASTIC REFRACTORIES**

## GENERAL REFRACTORIES LIMITED

Telephone : 31113 (6 lines)

**Genefax House, Sheffield, 10**

Telegrams : "Genefax, Sheffield"

**Manufacturers of Heat Resisting and Heat Insulating Materials of every description.**

**WORKS, OFFICES, MINES AND QUARRIES THROUGHOUT THE WORLD,**

**STAND Nos. D.913 & 810**

# RAW MATERIALS—PRICE LIST

**(Wednesday, January 20, 1937)**

## COPPER

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 51 | 8 | 9 |
| Three months | 51 | 10 | 0 |
| Electrolytic | 56 | 0 | 0 |
| Tough | 55 | 7 | 6 |
| Best selected | 55 | 17 | 6 |
| Sheets | 88 | 2 | 6 |
| India | 66 | 7 | 6 |
| Wire bars | 57 | 2 | 6 |
| Ingot bars | 57 | 2 | 6 |
| H.C. wire rods | 60 | 12 | 6 |
| Off. av. cash, Dec. | 45 | 19 | 8 1/4 |
| Do., 3 mths., Dec. | 46 | 5 | 10 1/4 |
| Do., Sttlmnt., Dec. | 45 | 19 | 6 1/4 |
| Do., Electro, Dec. | 50 | 13 | 9 |
| Do., B.S., Dec. | 50 | 13 | 0 |
| Do., wire bars, Dec. | 51 | 0 | 2 1/4 |
| Solid drawn tubes | | | 13d. |
| Brazed tubes | | | 13d. |
| Wire | | | 8d. |

## BRASS

| | |
|---|---|
| Solid drawn tubes | 11 1/2d. |
| Brazed tubes | 13 1/2d. |
| Rods, drawn | 10d. |
| Rods, extd. or rlld. | 6d. |
| Sheets to 10 w.g. | 9 1/2d. |
| Wire | 9 1/2d. |
| Rolled metal | 9 1/2d. |
| Yellow metal rods | 6d. |

## TIN

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 229 | 10 | 0 |
| Three months | 230 | 0 | 0 |
| English | 229 | 10 | 0 |
| Bars | 231 | 15 | 0 |
| Straits | 232 | 0 | 0 |
| Australian | 229 | 10 | 0 |
| Eastern | 232 | 2 | 6 |
| Banca | 231 | 10 | 0 |
| Off. av. cash, Dec. | 232 | 5 | 1 1/4 |
| Do., 3 mths., Dec. | 232 | 4 | 9 1/2 |
| Do., Sttlmt., Dec. | 232 | 5 | 8 1/4 |

## SPELTER

| | £ | s. | d. |
|---|---|---|---|
| Ordinary | 21 | 5 | 0 |
| Remelted | 17 | 10 | 0 |
| Hard | 18 | 10 | 0 |
| Electro 99.9 | 23 | 5 | 0 |
| English | 21 | 0 | 0 |
| India | 17 | 15 | 0 |
| Zinc dust | 25 | 10 | 0 |
| Zinc ashes | 6 | 0 | 0 |
| Off. aver., Dec. | 18 | 1 | 0 3/4 |
| Aver. spot, Dec. | 17 | 19 | 11 7/8 |

## LEAD

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt. | 27 | 6 | 3 |
| Empire | 27 | 6 | 3 |
| English | 29 | 5 | 0 |
| Off. aver., Dec. | 25 | 10 | 7 1/2 |
| Aver. spot, Dec. | 25 | 11 | 2 7/8 |

## ALUMINIUM

| | |
|---|---|
| Ingots | £100 to £105 |
| Wire | 1/3 to 1/4 lb. |
| Sheet and foil | 1/2 to 1/4 lb. |

## ZINC SHEETS, &c.

| | | | | | | |
|---|---|---|---|---|---|---|
| Zinc sheets, English | 31 | 5 | 0 | to 31 | 15 | 0 |
| Do., V.M. ex-whse. | 31 | 5 | 0 | to 31 | 15 | 0 |
| Rods | | | | 32 | 0 | 0 |

## ANTIMONY

| | | | | | | |
|---|---|---|---|---|---|---|
| English | 75 | 0 | 0 | to 76 | 0 | 0 |
| Chinese, ex-whse. | | | | 63 | 0 | 0 |
| Crude, c.i.f. | | | | 35 | 0 | 0 |

## QUICKSILVER

| | | | |
|---|---|---|---|
| Quicksilver | 14 | 2 | 6 |

## FERRO-ALLOYS AND STEEL-MAKING METALS

| | | | | | | |
|---|---|---|---|---|---|---|
| Ferro-silicon— | | | | | | |
| 25% | 9 | 2 | 6 | | | |
| 45/50% | 10 | 15 | 0 | to 12 | 0 | 0 |
| 75% | 15 | 15 | 0 | to 17 | 0 | 0 |
| Ferro-vanadium— | | | | | | |
| 35/50% | 12/8 lb. Va | | | | | |
| Ferro-molybdenum— | | | | | | |
| 70/75% carbon-free | 4/6 lb. Mo. | | | | | |
| Ferro-titanium— | | | | | | |
| 20/25% carbon-free | 9d. lb. | | | | | |
| Ferro-phosphorus, 20/25% | £21 to £22 | | | | | |
| Ferro-tungsten— | | | | | | |
| 80/85% | 3/- lb. | | | | | |
| Tungsten metal powder— | | | | | | |
| 98/99% | 3/1 1/2 lb. | | | | | |
| Ferro-chrome— | | | | | | |
| 2/4% car. | 31 | 17 | 6 | | | |
| 4/6% car. | 21 | 10 | 0 | | | |
| 6/8% car. | 21 | 0 | 0 | | | |
| 8/10% car. | 21 | 0 | 0 | | | |
| Ferro-chrome— | | | | | | |
| Max. 2% car. | 32 | 10 | 0 | | | |
| Max. 1% car. | 35 | 15 | 0 | | | |
| Max. 0.5% car. | 36 | 10 | 0 | | | |
| 70% carbon-free | 9 1/4d. lb. | | | | | |
| Nickel—99.5/100% | £180 to £185 | | | | | |
| "F" nickel shot | £165 | 0 | 0 | | | |
| Ferro-cobalt, 98/99% | 7/3 lb. | | | | | |
| Metallic chromium— | | | | | | |
| 96/98% | 2/5 lb. | | | | | |
| Ferro-manganese— | | | | | | |
| 76/80% loose | £11 | 15 | 0 | to 12 | 5 | 0 |
| 76/80% packed | £12 | 15 | 0 | to 13 | 5 | 0 |
| 76/80% export | £10 | 15 | 0 | | | |
| Metallic manganese— | | | | | | |
| 94/96% carbon-free | 1/3 lb. | | | | | |

Per ton unless otherwise stated, basis 2-ton lots.

## HIGH-SPEED TOOL STEEL

| | |
|---|---|
| Finished bars, 14% tungsten | 2s. 0d. |
| Finished bars, 18% tungsten | 2s. 9d. |

Per lb. net, d/d buyers' works.

| | |
|---|---|
| Extras— | |
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under 1/2 in. to 1/4 in. | 3d. lb. |
| Do., under 1/4 in. to 1/8 in. | 1/- lb. |
| Flats, 1/2 in. × 1/4 in. to under 1 in. × 3/8 in. | 3d. lb. |
| Do., under 1/4 in. × 1/4 in. | 1/- lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| South Wales— | | | | | | |
| Heavy steel | | | | 3 | 10 | 0 |
| Mixed iron and steel | 3 | 5 | 0 | to 3 | 7 | 6 |
| Heavy cast iron | 3 | 5 | 0 | to 3 | 7 | 6 |
| Good machinery | | | | 3 | 10 | 0 |
| Cleveland— | | | | | | |
| Heavy steel | | | | 3 | 2 | 6 |
| Steel turnings | | | | 2 | 5 | 0 |
| Heavy cast iron | | | | 3 | 10 | 0 |
| Heavy machinery | | | | 3 | 12 | 6 |
| Midlands— | | | | | | |
| Light cast-iron scrap | 2 | 15 | 0 | to 2 | 17 | 6 |
| Heavy wrought iron | | | | 3 | 10 | 0 |
| Steel turnings | 2 | 0 | 0 | to 2 | 2 | 6 |
| Scotland— | | | | | | |
| Heavy steel | | | | 3 | 2 | 6 |
| Ordinary cast iron | | | | 3 | 8 | 6 |
| Engineers' turnings | | | | 2 | 7 | 6 |
| Cast-iron borings | | | | 2 | 2 | 6 |
| Wrot-iron piling | | | | 3 | 12 | 6 |
| Heavy machinery | 3 | 13 | 6 | to 3 | 14 | 6 |

London—Merchants' buying prices, delivered yard.

| | | | |
|---|---|---|---|
| Copper (clean) | 42 | 0 | 0 |
| Brass | 25 | 0 | 0 |
| Lead (less usual draft) | 24 | 0 | 0 |
| Tea lead | 19 | 0 | 0 |
| Zinc | 13 | 0 | 0 |
| New aluminium cuttings | 74 | 0 | 0 |
| Braziery copper | 40 | 0 | 0 |
| Gunmetal | 40 | 0 | 0 |
| Hollow pewter | 170 | 0 | 0 |
| Shaped black pewter | 124 | 0 | 0 |

## PIG-IRON

| | |
|---|---|
| N.E. Coast (d/d Tees-side area)— | |
| Foundry No. 1 | 83/6 |
| ,, No. 3 | 81/- |
| ,, No. 4 | 80/- |
| Forge No. 4 | 80/- |
| Hematite No. 1 | 98/-* |
| Hematite M/Nos. | 97/6* |
| N.W. Coast— | |
| Hem. M/Nos. d/d Glas. | 98/-* |
| ,, d/d Birm. | 109/6* |
| Malleable iron d/d Birm. | — |
| Midlands (d/d Birmingham dist.)— | |
| Staffs No. 4 forge | 83/- |
| ,, No. 3 fdry. | 86/- |
| Northants forge | 80/6 |
| ,, fdry. No. 3 | 83/6 |
| ,, fdry. No. 1 | 86/6 |
| Derbyshire forge | 83/- |
| ,, fdry. No. 3 | 86/- |
| ,, fdry. No. 1 | 89/- |
| Scotland— | |
| Foundry, No. 1, f.o.t. | 90/6 |
| ,, No. 3, f.o.t. | 88/- |
| Cleveland No. 3, Glasgow | 87/- |
| ,, ,, Falkirk | 84/- |
| Scottish hem. M/Nos. d/d | 98/-* |
| Sheffield (d/d district)— | |
| Derby forge | 80/6 |
| ,, fdry. No. 3 | 83/6 |
| Lincs forge | 80/6 |
| ,, fdry. No. 3 | 83/6 |
| W.C. hematite | 103/6* |
| Lancashire (d/d eq. Man.)— | |
| Derby fdry. No. 3 | 89/- |
| Staffs fdry. No. 3 | 89/- |
| Northants fdry. No. 3 | 87/6 |
| Cleveland fdry. No. 3 | 89/- |
| Glengarnock, No. 3 | 105/- |
| Clyde, No. 3 | 105/- |
| Monkland, No. 3 | 105/- |
| Summerlee, No. 3 | 105/- |
| Eglinton, No. 3 | 105/- |
| Gartsherrie, No. 3 | 105/- |
| Shotts, No. 3 | 105/- |

* Subject to a rebate of 5s. per ton under certain conditions.

## FINISHED IRON AND STEEL

*Usual district deliveries for iron; delivered consumer's station for steel.*

| Iron— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Bars (cr.) | | | | 10 | 10 | 0 |
| Nut and bolt iron | 8 | 17 | 6 | to 9 | 7 | 6 |
| Hoops | | | 11 | 7 | 6 | and up. |
| Marked bars (Staffs) f.o.t. | | | | 13 | 0 | 0 |
| Gas strip | | | 11 | 7 | 6 | and up. |
| Bolts and nuts, 1/4 in. × 4 in. | | | | 16 | 0 | 0 and up. |
| Steel— | | | | | | |
| Plates, ship, etc. | 9 | 10 | 6 | to 9 | 13 | 0 |
| Boiler plts | 10 | 0 | 6 | to 10 | 3 | 0 |
| Chequer plts. | | | | 11 | 3 | 0 |
| Angles | | | | 9 | 3 | 0 |
| Tees | | | | 10 | 3 | 0 |
| Joists | | | | 9 | 3 | 0 |
| Rounds and squares, 3 in. to 5 1/2 in. | | | | 10 | 3 | 0 |
| Rounds under 3 in. to 1/4 in. (Untested) | | | | 9 | 10 | 0 |
| Flats—8 in. wide and over | | | | 9 | 8 | 0 |
| ,, under 8 in. and over 5 in. | | | | 9 | 13 | 0 |
| Rails, heavy | 8 | 5 | 0 | to 8 | 10 | 0 |
| Fishplates | | | | 12 | 10 | 0 |
| Hoops (Staffs) | | | | 10 | 5 | 0 |
| Black sheets, 24g. (4-t. lots) | | | | 12 | 0 | 0 |
| Galv. cor. shts. ( ,, ) | | | | 14 | 0 | 0 |
| Galv. flat shts. ( ,, ) | | | | 14 | 10 | 0 |
| Galv. fencing wire, 8g. plain | | | | 15 | 10 | 0 |
| Billets, soft | | | | 6 | 5 | 0 |
| Sheet bars | 6 | 2 | 6 | to 6 | 10 | 0 |
| Tin bar | 6 | 2 | 6 | to 6 | 10 | 0 |

## PHOSPHOR BRONZE

| | Per lb. basis |
|---|---|
| Strip | 12 1/2d. |
| Sheet to 10 w.g. | 13 1/2d. |
| Wire | 14 1/2d. |
| Rods | 14d. |
| Tubes | 16 1/2d. |
| Castings | 14d. |

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## NICKEL SILVER, &c.

| | Per lb. |
|---|---|
| Ingots for raising | 8d. to 1/2 |
| Rolled— | |
| To 9 in. wide | 1/2 to 1/8 |
| To 12 in. wide | 1/2 1/4 to 1/8 1/4 |
| To 15 in. wide | 1/2 1/2 to 1/8 1/2 |
| To 18 in. wide | 1/3 to 1/9 |
| To 21 in. wide | 1/3 1/2 to 1/9 1/2 |
| To 25 in. wide | 1/4 to 1/10 |
| Ingots for spoons and forks | 8d. to 1/4 1/2 |
| Ingots rolled to spoon size | 11d. to 1/7 1/2 |
| Wire round— | |
| to 10g. | 1/5 1/2 to 2/0 1/2 |

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4 1/2 upwards.

## AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 22.31 |
| No. 2 foundry, Valley | 20.50 |
| No. 2 foundry, Birm. | 16.88 |
| Basic, Valley | 20.00 |
| Malleable, Valley | 20.50 |
| Grey forge, Valley | 20.00 |
| Ferro-mang. 80%, seaboard | 80.00 |
| O.-h. rails, h'y, at mill | 39.00 |
| Billets | 34.00 |
| Sheet bars | 34.00 |
| Wire rods | 43.00 |
| | Cents. |
| Iron bars, Chicago | 2.15 |
| Steel bars | 2.20 |
| Tank plates | 2.05 |
| Beams, etc. | 1.90 |
| Skelp, grooved steel | 1.80 |
| Steel hoops | 1.95 |
| Sheets, black, No. 24 | 2.80 |
| Sheets, galv., No. 24 | 3.40 |
| Wire nails | 2.25 |
| Plain wire | 2.60 |
| Barbed wire, galv. | 2.70 |
| Tinplates, 100-lb box | $4.85 |

## COKE (at ovens)

| | |
|---|---|
| Welsh foundry | 30/- to 32/6 |
| ,, furnace | 24/6 to 25/- |
| Durham foundry | 24/3 to 25/- |
| ,, furnace | 21/3 to 22/- |
| Scotland, foundry | 28/- |
| ,, furnace | — |

## TINPLATES

f.o.b. Bristol Channel ports.

| | | | |
|---|---|---|---|
| I.C. cokes | 20×14 per box | | 19/9 to 20/3 |
| ,, | 28×20 | ,, | 39/6 to 40/- |
| ,, | 20×10 | ,, | 28/- to 28/3 |
| ,, | 18 3/4×14 | ,, | 20/6 to 21/- |
| C.W. | 20×14 | ,, | 17/- to 17/3 |
| ,, | 28×20 | ,, | 35/6 to 35/9 |
| ,, | 20×10 | ,, | 23/9 to 24/- |
| ,, | 18 3/4×14 | ,, | 17/3 to 17/6 |

## SWEDISH CHARCOAL IRON & STEEL

| | | | | | | |
|---|---|---|---|---|---|---|
| Pig-iron | £8 | 0 | 0 | to £9 | 0 | 0 |
| Bars-hammered, basis | £16 | 0 | 0 | to £16 | 10 | 0 |
| Bars and nail-rods, rolled, basis | £15 | 15 | 0 | to £16 | 0 | 0 |
| Blooms | £12 | 0 | 0 | to £14 | 0 | 0 |
| Keg steel | £26 | 0 | 0 | to £29 | 0 | 0 |
| Faggot steel | £18 | 0 | 0 | to £23 | 0 | 0 |
| Bars and rods dead soft, st'l | £11 | 0 | 0 | to £12 | 0 | 0 |

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

**DAILY FLUCTUATIONS**

**Standard Copper** (cash)

| | | | £ | s. | d. | |
|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 53 | 5 | 0 | dec. 20/– |
| ,, | 15 | .. | 52 | 17 | 6 | ,, 7/6 |
| ,, | 18 | .. | 52 | 6 | 3 | ,, 11/3 |
| ,, | 19 | .. | 50 | 6 | 3 | ,, 40/– |
| ,, | 20 | .. | 51 | 8 | 9 | inc. 22/6 |

**Electrolytic Copper**

| | | | £ | s. | d. | |
|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 58 | 0 | 0 | dec. 20/– |
| ,, | 15 | .. | 57 | 15 | 0 | ,, 5/– |
| ,, | 18 | .. | 57 | 5 | 0 | ,, 10/– |
| ,, | 19 | .. | 55 | 0 | 0 | ,, 45/– |
| ,, | 20 | .. | 56 | 0 | 0 | inc. 20/– |

**Standard Tin** (cash)

| | | | £ | s. | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 231 | 5 | 0 | inc. | 5/– |
| ,, | 15 | .. | 232 | 5 | 0 | ,, | 20/– |
| ,, | 18 | .. | 231 | 15 | 0 | dec. | 10/– |
| ,, | 19 | .. | 229 | 10 | 0 | ,, | 45/– |
| ,, | 21 | .. | 229 | 10 | 0 | No change | |

**Tin** (English ingots)

| | | | £ | s. | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 231 | 10 | 0 | inc. | 5/– |
| ,, | 15 | .. | 232 | 5 | 0 | ,, | 15/– |
| ,, | 18 | .. | 232 | 0 | 0 | dec. | 5/– |
| ,, | 19 | .. | 229 | 15 | 0 | ,, | 45/– |
| ,, | 20 | .. | 229 | 10 | 0 | ,, | 5/– |

**Spelter** (ordinary)

| | | | £ | s. | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 22 | 12 | 6 | dec. | 2/6 |
| ,, | 15 | .. | 22 | 11 | 3 | ,, | 1/3 |
| ,, | 18 | .. | 21 | 13 | 9 | ,, | 17/6 |
| ,, | 19 | .. | 20 | 5 | 0 | ,, | 28/9 |
| ,, | 21 | .. | 21 | 5 | 0 | inc. | 20/– |

**Spelter** (Electro, 99.9 per cent.)

| | | | £ | s. | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 24 | 11 | 3 | dec. | 2/6 |
| ,, | 15 | .. | 24 | 10 | 0 | ,, | 1/3 |
| ,, | 18 | .. | 23 | 13 | 9 | ,, | 16/3 |
| ,, | 19 | .. | 22 | 5 | 0 | ,, | 28/9 |
| ,, | 20 | .. | 23 | 5 | 0 | inc. | 20/– |

**Lead** (soft foreign, prompt)

| | | | £ | s | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 28 | 2 | 6 | dec. | 8/9 |
| ,, | 15 | .. | 27 | 13 | 9 | ,, | 8/9 |
| ,, | 18 | .. | 27 | 3 | 9 | ,, | 10/– |
| ,, | 19 | .. | 26 | 11 | 3 | ,, | 12/6 |
| ,, | 20 | .. | 27 | 6 | 3 | inc. | 15/– |

**Lead** (English)

| | | | £ | s. | d. | | |
|---|---|---|---|---|---|---|---|
| Jan. | 14 | .. | 30 | 5 | 0 | dec. | 5/– |
| ,, | 15 | .. | 29 | 15 | 0 | ,, | 10/– |
| ,, | 18 | .. | 29 | 5 | 0 | ,, | 10/– |
| ,, | 19 | .. | 28 | 10 | 0 | ,, | 15/– |
| ,, | 20 | .. | 29 | 5 | 0 | inc. | 15/– |

**Imports and Exports of Pig-iron, Castings, etc., in December and the Twelve Months 1936, compared with December and the Twelve Months 1935**

| | December. | | Twelve months. | | December. | | Twelve months. | |
|---|---|---|---|---|---|---|---|---|
| | 1935. | 1936. | 1935. | 1936. | 1935. | 1936. | 1935. | 1936. |
| | Tons. | Tons. | Tons. | Tons. | £ | £ | £ | £ |
| *Imports.* | | | | | | | | |
| Pig-iron—from British India | 6,860 | 20,366 | 67,383 | 144,034 | 20,644 | 66,896 | 202,160 | 462,264 |
| ,, Foreign Countries | 2,050 | 2,493 | 16,854 | 103,314 | 11,585 | 14,978 | 97,998 | 364,187 |
| Total | 8,910 | 22,859 | 84,237 | 247,348 | 32,229 | 81,874 | 300,158 | 826,451 |
| Castings and forgings | 532 | 330 | 3,509 | 6,348 | 16,230 | 11,740 | 97,329 | 220,713 |
| Cast pipes and fittings | 189 | 299 | 1,738 | 1,785 | 4,153 | 7,184 | 44,247 | 56,764 |
| Stoves, grates, etc. | 77 | 68 | 1,132 | 834 | 4,258 | 8,116 | 90,325 | 76,566 |
| Baths | 560 | 940 | 6,820 | 8,498 | 14,038 | 21,364 | 180,419 | 203,830 |
| Hollow-ware, all kinds | 208 | 420 | 2,610 | 3,984 | 14,049 | 20,852 | 171,107 | 203,456 |
| *Exports.* | | | | | | | | |
| Pig-iron, forge and foundry | 5,603 | 5,477 | 92,728 | 57,529 | 20,059 | 23,317 | 322,802 | 224,218 |
| ,, acid | 3,705 | 4,010 | 48,752 | 41,661 | 12,757 | 15,901 | 158,689 | 154,454 |
| ,, basic | — | 5 | 829 | 428 | — | 25 | 2,650 | 1,633 |
| Total | 9,308 | 9,492 | 142,309 | 99,618 | 32,816 | 39,243 | 484,141 | 380,305 |
| Castings and forgings | 266 | 361 | 3,944 | 4,069 | 11,162 | 12,843 | 152,615 | 151,794 |
| Cast pipes and fittings up to 6 in. diameter | 4,471 | 5,145 | 58,822 | 58,086 | 52,165 | 55,574 | 655,574 | 646,759 |
| ,, ,, ,, ,, over 6 in. | 5,037 | 2,785 | 36,493 | 38,715 | 41,356 | 23,019 | 297,787 | 317,706 |
| Stoves, grates, etc. | 961 | 999 | 9,265 | 10,665 | 48,060 | 53,322 | 471,500 | 539,564 |
| Sanitary cisterns | 258 | 317 | 3,135 | 3,046 | 8,638 | 9,842 | 93,292 | 95,187 |
| Bedsteads, including tubes therefor | 421 | 472 | 4,620 | 5,030 | 15,299 | 16,075 | 169,399 | 182,989 |
| Hollow-ware | 457 | 524 | 4,424 | 5,641 | 15,598 | 18,409 | 161,405 | 202,103 |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CONSULTANT on foundry work, comprising iron, steel, non-ferrous alloys, including aluminium and light alloys, acts independently. Unbiased reports given, based on 25 years' experience. Also arrange reports for company reorganisation. In strictest confidence write: Box 194, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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ASSISTANT Roll Foundry Manager required. Metallurgical knowledge of iron and steel essential. State age, experience, and salary required to: Box 188, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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FIRST-CLASS Man with experience in production of light castings and cupola practice. Must be good organiser, able to plan and price work.

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**Chattan Foundry,**
**BONNYBRIDGE.**

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